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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

A JUNGLE GARDEN

Religion and Family Size — **Inherited "Big-Head" in Horses**

New Characters in Cotton

APRIL, 1928 — Vol. 19, No. 4

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The

Journal of Heredity

VOL. XIX, NO 4. APRIL, 1928

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The JOURNAL OF HEREDITY is published monthly by the

AMERICAN GENETIC ASSOCIATION

At 1918-32 Harford Avenue, Baltimore, Md., and Victor Building, Washington, D. C.

Address communications regarding editorial matters and the business management of the Association to Room 306, Victor Building, Washington, D. C.

Entered as second class matter February 24, 1923, at the postoffice at Baltimore, Maryland. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized December 20, 1918. **Contents copyrighted 1928 by the American Genetic Association. Reproduction of articles or parts of articles permitted only upon request, for a proper purpose, and provided due credit is given to the author and to the JOURNAL OF HEREDITY, Washington, D. C.**

Date of issue of this number, April 20, 1928

$3.50 *a Year;* 35c *the Copy, for current numbers*

Photograph by P. H. Dorsett.

AN AMAZINGLY RAPID GROWING PALM

Frontispiece

The rattan palm (*Pigafettia elata*) was planted at the same time that the Royal palms (*Oreodoxa regia*) on either side were planted, only six and a half years ago. The rattan palm is now sixty feet tall. Mr. J. A. Loerzing, the Director, standing. Sibolangit Plant Garden, North Sumatra.

A JUNGLE BOTANIC GARDEN

The Sibolangit Garden in the Highlands of Sumatra

DAVID FAIRCHILD

THE GUEST HOUSE AT SIBOLANGIT

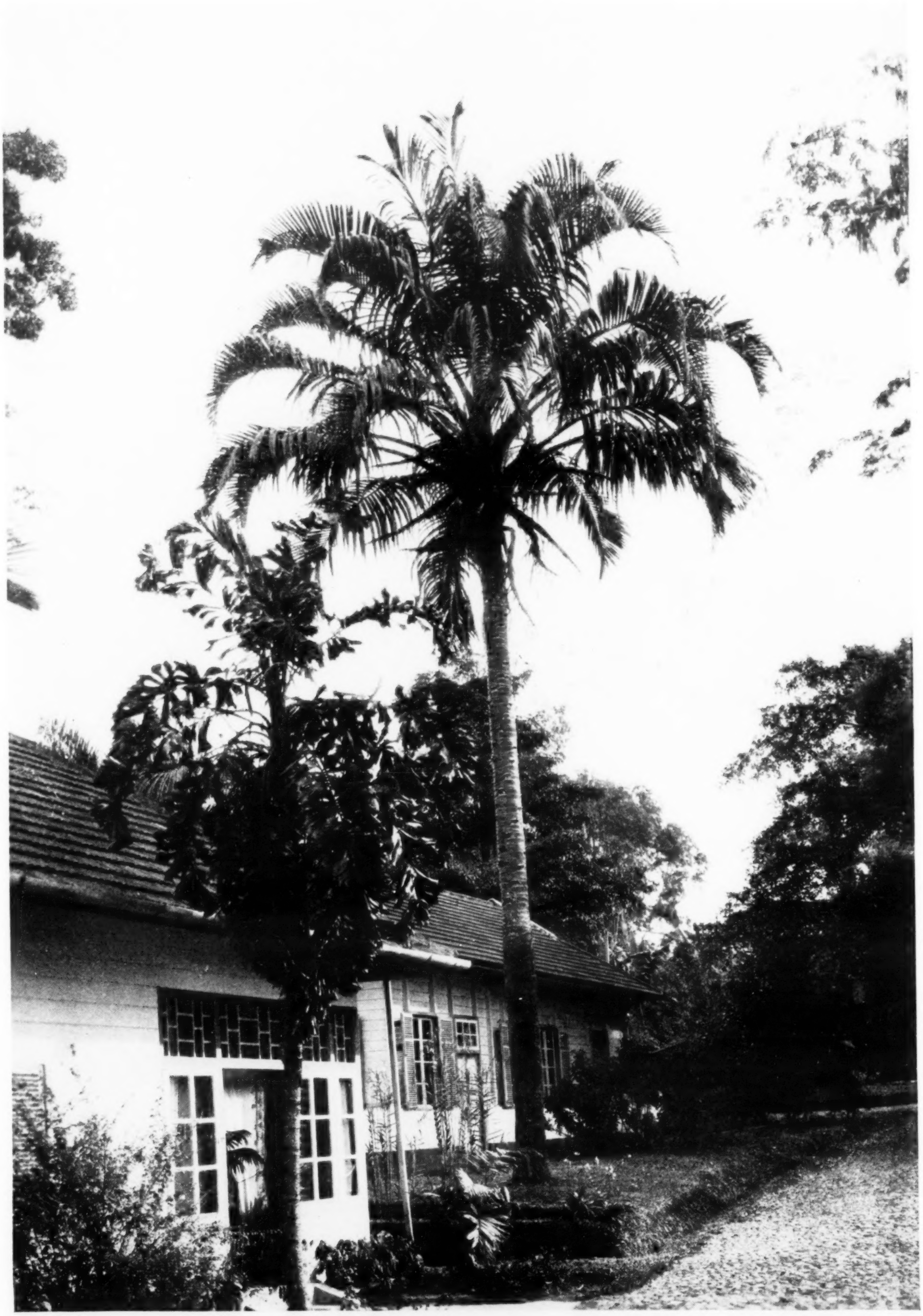
Figure 1

The Guest House is equipped with beds, tables, and cupboards ready for visitors. It stands a dozen paces back from the through highway to Brestagi (the delightful health resort of the Sumatra Highlands) and overlooks a superb tropical valley of giant forest trees and lianas. The Sumatra rattan palm (*Calamus draco*) guards its entrance, a scarlet-flowered species of passiflora (*P. vitifolia*) with enormous extra-floral nectaries grows just back of the house. *Ficus toxicaria* and wonderful tree ferns are on the edge of the cliff, and that superb tropical crepe myrtle *Lagerstroemia flos-reginae* blooms beside the window

A GARDEN may be anything from a rock-pile in somebody's back yard to a park covering half a thousand acres of land. At Sibolangit in Sumatra there is a Botanic Garden, but when I run over in my mind the scores of Botanic Gardens that I have seen all over the world and try to fit Sibolangit into the abstraction, "Botanic Garden," it hardly fits at all. Yet measured by the really botanical thrills which it gave me, it surpasses them all.

I know the conventional way of describing a Botanic Garden is to give a map with boundaries and follow with a list of scientific names, but I am confident that this method no more gives an idea of what a garden really is than a pale pink irregular spot on a map marked "Java" gives any hint of the beauties of that marvellous island.

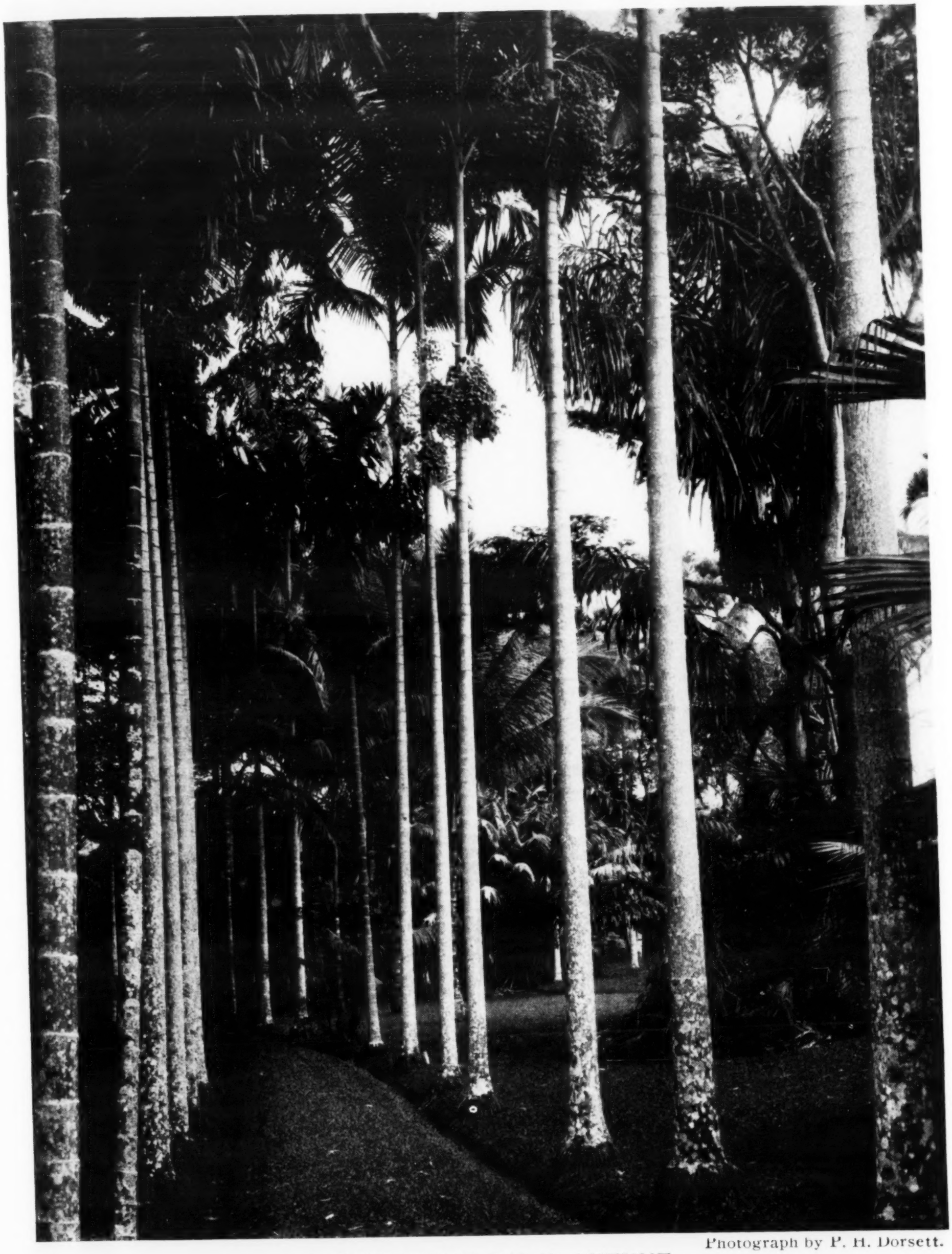
One morning, glorious with sunshine and the songs of warblers, my friend Howard Dorsett and I strolled across to this Botanic Garden from a



HERBARIUM AND HEADQUARTERS OF THE SIBOLANGIT GARDEN

Figure 2

Mr. Loerzing's bungalow in foreground, and herbarium building behind, with a rattan palm seven years old in front of it. A lath house and conservatory stand behind, modest equipment for so wonderful a garden.



Photograph by P. H. Dorsett.

A MINIATURE PALM AVENUE

Figure 3

This is not a Royal palm, but a daintier, more slender species (*Actinorhytis calapparia*), a monotypic genue native of Malaya. It is particularly well suited for narrow pathways. The palms shown here are less than twelve years old and they border a pathway six feet wide in the Sibolangit Garden of North Sumatra.

little guest house under a great Rattan Palm (*Calamus draco*) whose dangling hook-set tips had torn a piece out of my ear. We found Director Loerzing already at work in his modest herbarium. He was preparing some specimens which he had smoked in a special smoke-oven which dries them and kills all the insects and moulds as well. Quiet, seclusion, books enough, and a botanist with unfailing enthusiasm and a love of plant forms, were there; a combination I have failed so often to find in other gardens I have visited.

We had been at the garden before, and Mr. Loerzing had introduced us to a few of the 2500 or 3000 interesting species of plants which grow along its incomparable trails. Among these he had shown us a bamboo (*Schizostachyum blumei*), different from any I had ever seen before,—with joints or internodes nearly six feet long,—longer than the barrel of Davy Crockitt's squirrel rifle. This is the plant from which the native Battaks make their marvellous blow guns. He had given me a tiny plant of this bamboo, but we wanted a whole "Wardian case" full, to send to America, in order to establish this remarkable species in the Western Hemisphere where today it is utterly unknown.

So this morning I spoke to Mr. Loerzing about it again and he said that he would call a couple of coolies and we would go out into the garden and get the plants and be back in three-quarters of an hour. His words sounded much like those I had so often heard other botanic garden directors use when they start out to the Crataegus or Quercus section of their garden after a specimen.

Mountaineering in Sibolangit

But collecting a few bamboo plants in the Sibolangit garden is vastly different from getting Cratægi in the Arnold Arboretum or acorns in Kew Gardens. Klawong in hand, Mr. Loerzing started down one of the trails into the garden wilderness below the herbarium. We followed at first a closely cut grass path, but as soon as we located the coolies who were to accompany us, we plunged down the steep sides of a gorgeous valley several hundred feet deep. Below were nothing but rattans and all kinds of uninviting spiny plants to stop my slide if my feet slipped, and I was soon obliged to cling with hands and knees and crawl under overhanging underbrush. Cutting our way through tall grass and gorgeous tropical ferns and aroids and Scytamineae we came to a rotting palm stem bridging, after a fashion, a gully that led precipitately into the great valley below. I began to realize that I had on the wrong shoes for this mountain-side scramble, for their crepe rubber soles failed to grip the loose soil. Then a tropical hornet warned me by its sting that I was too near its nest and a plant of the nettle *Laportea* brushed against my ankle, leaving its burning trail, and I struck my knee against the spicules of some plant I had not even noticed but which left imbedded in my skin stinging hairs like those of certain vicious species of Mucuna.

Down I slipped and crawled, with Mr. Loerzing ahead of me and Dorsett behind to jeer at me, and all this time I was in the Botanic Garden of Sibolangit. Every time I looked out from the steep hillside—wiping my glasses which were dimmed with dripping perspiration—I saw below me a gorgeous valley filled with hundreds of species of forest trees covered with lianas. It was one of those hazily mysterious valley scenes that can be found only in the tropics; and this marvellous valley too was a part of the "Botanic Garden." How very different from the close-cut lawns of the Peradeniya Garden and how vastly more real! It made me wonder if, after all, the idea of a lawn in the tropics (necessary as it may be if one is afraid of snakes or if one is growing specimen exotic trees)—is not simply an example of our determination to take our preconceived idea of a

garden which we have acquired in the North with us into the tropics where it does not belong. It may be a part of the same insistence which makes us grow northern roses under the palms where they are about as appropriate as are tropical Agaves in green boxes under the pines of the North.

No! I was really in a tropical garden where tropical plants were living in their own proper environment, and no northern intellect had forced them into parks or grown them on gas-pipe arbors, or planted them in "beds" or disgraced them by those inevitable glaring white labels which bear their pedantic Latin names.

Of course I was not learning the names of all these plants, that was true. I was hanging on with both hands and digging my heels into the hillside to prevent myself from sliding a hundred feet or two into what would have been my last resting place. To lose ones life by falling over a precipice might be romantic but who among a botanist's friends would ever be able to understand his being killed in a Botanical Garden, of all places! I thought of the artificial mound in the Shaw Botanic Garden; of Professor Sargent's Hemlock Hill in the Arnold Arboretum; of the flat landscapes at Kew and the miniature dwarfed pines in Tokyo—in fact I ran through the whole category of gardens I had visited as I sat there on the steep slopes of Sibolangit and determined that I must not slide down into the rattan palms, that it would be an act which no botanic garden director would ever forgive. The distinction of being the first botanist to lose his life in a botanic garden was not one that I coveted.

We pushed on, and the trail got easier. In half an hour we came out under a great clump of the bamboo we were seeking, fastened to the hill side like some giant tuft of grass, its superb culms shooting every way in a wild whirl. With our klawongs we dug out the clumps, left two coolies to bring them back, and taking what Mr. Loerzing called an easy trail, we started back to the herbarium. I noted again and again that the trail ended—once in great masses of tall grass, once by the fallen culms of a clump of giant *Dendrocalamus*,—and all the time Mr. Loerzing was up-braiding his Battak gardeners for having neglected their duty—that of keeping the trails open. At last we came to a flight of steps—like those one sees all around the Mediterranean—rough approximations of real stairs. Of this Mr. Loerzing was particularly proud, and although I puffed and blew before we reached its top, Mr. Loerzing assured me that it was far superior to what his visitors had had to use before; until recently it had been a knee and toe scramble up an almost perpendicular gorge.

Every step of that climb up and down was punctuated by Director Loerzing with enthusiastic descriptions of the plants which grew over and around the trail—from the superb velvet-leaved orchid in the damp cleft near the waterfall to the brilliant scarlet flowers of various Marantaceae, which like great tulips spattered the dead leaves of the deep shady places. Tropical cicadas were singing constantly and the distant cries of monkeys and the barking of the dogs which were chasing them from their favorite fruit trees—all in the botanic garden—added to the experience of this little walk to the "Bamboo Quarter."

A Tanglefoot Tree and Other Features

But although this was the most strenuous, it was not the most interesting day by any means of those we spent in this most remarkable garden. I remember one in which we trailed Mr. Loerzing with our cameras, trying to record if we could, the moments when the interesting sights we saw rose to be real thrillers.

We started out, as always, on grassy paths from the formal part of the garden where Mr. Loerzing has planted many representative Sumatra

THE TWELVE-YEAR TRANSFORMATION

Figure 4

In the palm quarter of the Sibolangit Garden of the Sumatra Highlands. Twelve years ago this land was covered with weeds and tall grasses, as it shown at the left in the picture taken of this part of the garden before work was begun. None of the trees are over twelve years old.

Photograph by P. H. Dorsett.

THE FOREST-COVERED HILLS OF SUMATRA

Figure 5

View across the Lea Benuva towards Medan showing forest-covered hills scattered like sand dunes over the plain. Taken from the mesa-like center of the Sibolangit Garden, Sumatra. There are probably more different species in sight from where this photograph was taken than there are in the whole British Isles.

species of trees. The Bird-Lime tree, *Pisonia excelsa*, was not in fruit, unfortunately, and until I saw the fruits later and felt how inconceivably sticky they were, I could scarcely believe the account of how the birds which light upon them are so "gummed" that they cannot fly away, and are found helplessly struggling beneath the tree. The facts seem to be substantiated, however, and the literature records the observations of reliable men. The long narrow fruits produced in large clusters are covered with a true bird lime and birds lighting on them are caught on it and in struggling get their wings stuck together. From the evident discomfort shown by Mr. Loerzing's dog, when he came to his master to have the fruits removed from his hair, I was able to imagine the plight of a bird which was so unlucky as to light on a Pisonia tree in fruit.

Over the trail hung an Annona in which was a black paper nest of one of the many black ants of the tropics. We hacked it open and let its myriads of inmates crawl over our hands. It was one of those structures which only instincts of a high order could possibly produce—not like a bird's nest, the work of a pair of individuals but the result of an organization which compares favorably with some of the highest efforts of humans. We find it hard to ascribe intelligence to these tiny, almost microscopic creatures, and yet, without something very like intelligence how it is possible that such a complicated structure could be built?

Over the trail like gigantic ostrich plumes hung the leaves of the *Nicolaia speciosa*, a member of the Marantaceae. I never failed to be intrigued by the beauty of these tremendous leaves—some of them over 30 feet long; so long and so heavy in fact that it took two of us to raise one and hold it like a flag pole in the air. Its brilliant smooth midribs reminded me in their texture and color of the giant stems of the Sacred Papyrus as I once saw them in the little river at Syracuse in Sicily.

Beside the trail stood an innocent-looking small tree which, as we passed, I might have stroked with my hand had I not learned by rather long experience not to caress every plant I see in tropical jungles. It was, perhaps, one of the most dangerous of our tropical trees, for its poisonous hairs sting with such virulence that as Mr. Loerzing expressed it, "If a man should fall into a thicket of the Laportea he would either go insane from the irritation or commit suicide."

Towering high above our heads stood a stately Durian tree, the fruits of which have such a charm for those who like them that it is said murders have been committed in the quarrels between natives over its odorous fruits. In Sumatra a single fruit brings sixty cents Dutch and a tree will yield three hundred florins worth of fruit.

I know of no fruit of any kind that represents quite so strikingly the difference in human likes and dislikes. You find among individuals of all races who know it, some who detest it and others who adore it, and I have an idea that psychologists might find out something about the important matter of human taste by a closer study of this amazingly malodorous and yet deliciously flavored fruit. A knowledge of why the same fruit can have an odor that makes some people ill and a flavor that drives others to murder in order to satisfy their craving for it, might throw a light on the apparent vagaries of the human palate.

Scattered over the path were giant leaves, a foot across, dropped from young teak trees that had grown up in a single year in a clearing in the garden. While these leaves seemed small as compared with palm leaves forty feet long, yet the teak is a deciduous tree and in other respects reminds one of our northern tree species. A few steps further on Mr. Loerzing picked up a leaf of another deciduous tree, a *Barringtonia* that was a meter and a half long.

The monkeys had been at the fruits of the "Asam Gloegur" (*Garcinia atroviridis*) and the great golden fruits

on the ground had been opened and the seeds (which I wanted particularly) together with the yellow pulp removed. To the seed collector in tropical forests monkeys are a nuisance. They have the advantage over him. But by means of a long slender stick and a twisting movement Mr. Loerzing was able to get a fruit of this most interesting relative of the famous Mangosteen. It is much larger. Its rind is golden yellow and nearly an inch thick. When it ripens, this rind springs apart into a dozen segments much as the rind of a hickory nut does at home and reveals the small amount of pulp and seeds inside. These rind segments are the most intensely sour things I ever tasted, with a flavor like strong hydrochloric acid. The natives of Ceylon and Sumatra dry them—in which process they turn perfectly black—and use them for flavoring curry dishes. They put a segment into the curry and take it out again as one does a leaf of laurel.

Hanging high up among the branches of the jungle trees I saw the great red pods of a *Mucuna*—a relative of our velvet bean. I wanted to see the stinging hairs of this species. We tore down the lianas, but it took the combined strength of three of us. In its fall, some of the brown stinging hairs were brushed off and landed on my son Graham's bare neck—to his great discomfort. The Battaks say, so Mr. Loerzing informed us, that "if you see this vine it's not dangerous, it's only when you don't see it that it hurts you."

As we walked along, still over a grassy path through the forest we approached one of the few lookouts which have been provided and which made us realize that the land we had been walking on was in the nature of a mesa with precipitous sides and surrounded below by a vast forest stretching nearly to the horizon. Such beauty! We could see a rainstorm over the City of Medan, 30 miles away. Between us and the city were vast rubber and tobacco estates, and the densely forested hills nearer to us were like giant sand dunes in their arrangement and shape. I have never seen, anywhere, a more lovely tropical forest view from above the tree-tops than this in the Sibolangit Garden.

We turned, and at a bend in the path, as though prearranged by the director, a new cicada sang. Such shrillness and force I had never heard before, and such beauty too. Graham has a collection of cicadas ranging in size from half an inch long to fully five inches, but of them all, I like this one best, with its black head and brilliant green band across the thorax. Like Mark Twain and the Swiss yodlers we found the first we heard very interesting, but before we left that part of the garden where they live, I'd have gladly exterminated the species.

A Battak Stronghold

We were approaching that part of the garden, where, according to tradition. the Battaks had a stronghold, and to get there we had to go, single file, across a narrow natural causeway now long since overgrown with ferns. This causeway was only a footpath wide, a knife edge, from which the ground dropped on either side several hundred feet into the vallew below, and though the ferns concealed somewhat the sternness of the precipices, I felt, as I walked across, no impulse whatever to let my eyes wander from the narrow trail itself.

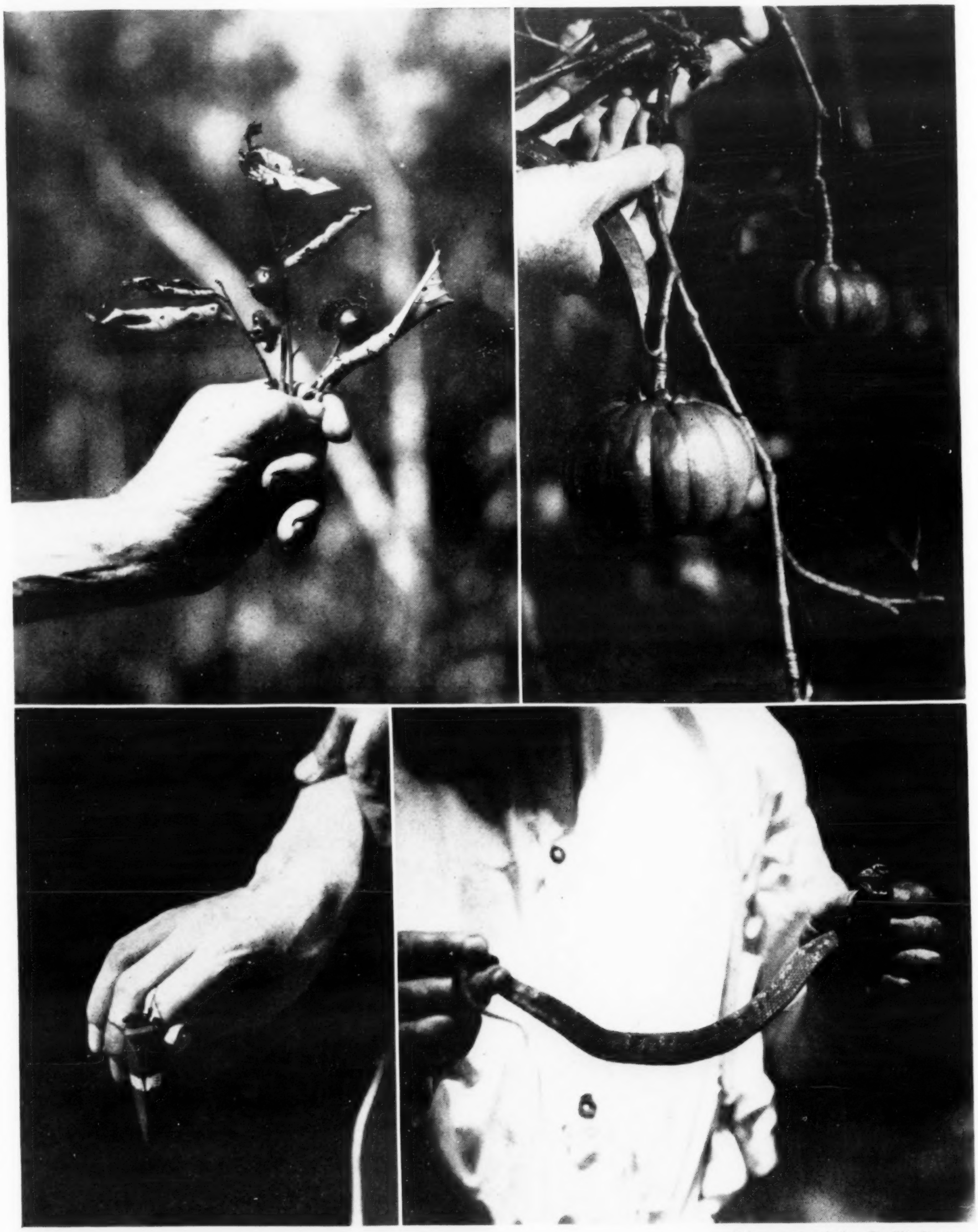
Once across we were on a pinnacle of land completely surrounded by sheer precipices, but so dense was the bamboo thicket and the growth of tall grasses, that, as Mr. Loerzing remarked, we might be in one of the grass savannahs of East Africa. I have been on pinnacles before but I never saw one in a Botanic Garden, nor have I seen one that compared with this in its charm of vegetation or its outlook over the forest.

In the very spot where the Battaks would have put their portcullis, had they made one, we found some acorns, true acorns like those on the forest floor in my Maryland wood-lot.

SCENES IN A SUMATRA BOTANIC GARDEN

Figure 6

Upper left—Mr. Loerzing holding a leaf of a native species of *Barringtonia* that was five feet long. Right upper and lower left—Views from Sibolangit Garden showing the virgin forest and mountains of the Sumatra Highlands. Right lower—Mr. Loerzing and the author holding erect a leaf of *Nicolaia speciosa* which was 32 feet tall. As the leaf of this species rises from an underground rhizome and forms large clumps the effect of tropical luxuriance is amazing.



Photograph by P. H. Dorsett.

FEATURES OF THE SIBOLANGIT GARDEN

Figure 7

Left upper—Acorns of an unnamed tropical oak, an evergreen jungle species. Right upper—Fruits of *Garcinia atroviridis*, the Asam Gloegur, freshly cut from the forest tree. Lower left—A piercing voiced cicada with the brilliant green band across its throat. Right lower—A brilliant green viper which is said to be deadly if it bites, but which never bites. There is a snake temple in Penang where scores of a related species of vipers are kept loose to prove the efficacy of the priests who handle them. Mr. Loerzing traps the various poisonous snakes that occur in his gardens, including the cobra.

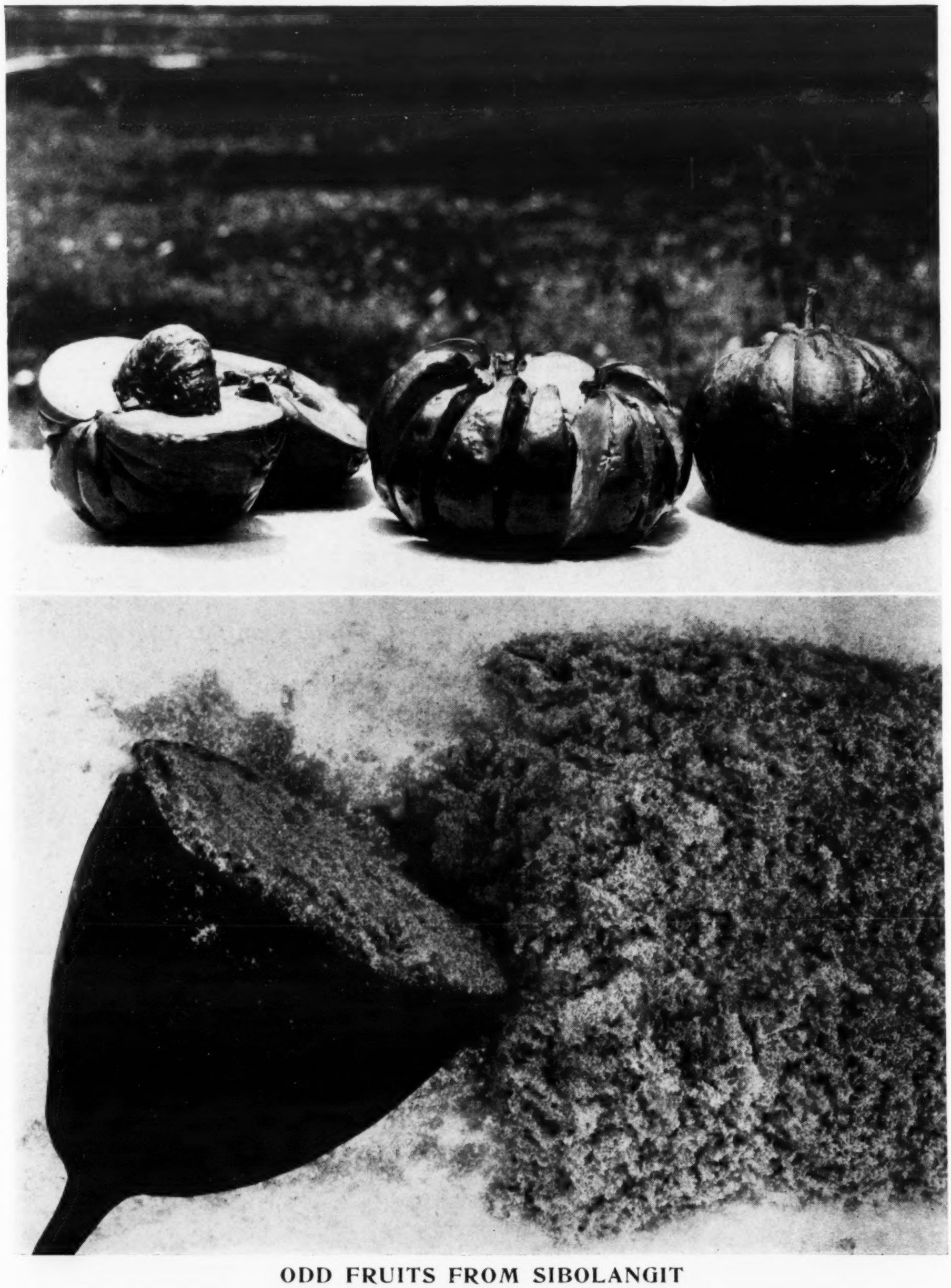
There are many oaks in North Sumatra—some with acorn mosses which are more ornate than any I have seen in northern climates, which look in fact likes pieces of carved Chinese jade, and are quite as beautiful.

Returning from the Battak pinnacle I tarried behind and entered a grove of the rare mountain relative of the famous Sugar Palm, *Arenga obtusifolia*. Its great stems and enormous leaves made a strange association on the steep slope of the hillside. So steep it was that when I knocked the nuts from the trees they rolled out of sight down the hillside. I will long remember the curious stillness of that palm grove on the mountain slope. I was conscious of being terribly alone and away from every human thing and was moved to the very center of my being with the joy of standing where life in marvellous forms surrounded me completely and where no familiar sounds reminded me of the world of noisy human beings. Yet I was, in reality, in a Botanic Garden.

Another morning, with the large camera, Mr. Howard Dorsett and I followed Mr. Loerzing along a narrow trail, cut under the cliff, where we had to stoop to get through. We wanted to get a photograph from it of the marvellous valley below. Mr. Loerzing, to clear the view, reached up and tugged at a great Liana. He was so near the brink that I held on to his trousers to steady him, but it was not until the coolie, with his klawong cut the liana through and I heard the whole tangle of vines crash 300 feet into the valley below us that I suspected upon what a narrow brink we had stood. Where in all the world can one find a botanic garden with such a trail? It reminded me of trails I had shuddered over in the Glacier National Park or in the Alps.

This remarkable garden and plant reserve covers 150 hectares (over 300 acres), 100 of which is in virgin forest, 18 hectares only in the systematic botanic garden, so-called, and 20 in the plateau set aside for experiment station uses.

It was not begun until 1915 and is due to the initiative of Dr. Koeningsberger who followed my old friend Melechoir Treub as director of the great botanic garden in Buitenzorg and who is now the minister of colonies in the Hague. It was Dr. Koeningsberger who selected Mr. A. J. Loerzing to build it up; a naturalist and botanist of the old school who began his life on the edge of the Thuringer Wald and has an unquenchable enthusiasm for the forms and behaviour of plants. With very small funds the garden has been maintained under his management and what strikes one as a remarkable number of interesting plants have been gathered together. Though we came fresh from Peradeniya with its great collections, I saw for the first time in this 18 hectare garden the rattan palm, *Pigafettia elata*, from the Moluccas, which in six and a half years had grown to 60 feet in height and which, it seems to me rivals the Royal in stateliness. *Artocarpus elastica*, a magnificent forest tree, with useful fruit and sticky latex, *Pinus merkusii*, the great turpentine pine of Sumatra. *Actinorhytis calapparia*, the superb palm resembling the Betel Nut Palm, but becoming stockier with age. *Grammatophyllun speciosum* queen of the orchids. *Macrozanonia macrocarpa*, with its polymorphus foliage, which in the beginning looks like the small foliage of *Ficus ripens*, as one sees it in the greenhouses, but when it reaches the highest branches of the trees this foliage becomes hundreds of times larger. It produces a fruit the size of a pumpkin containing thousands of great flat winged seeds. *Bucklandia*, a genus which is closely related to our sweet gum of the Southern States (*Liquidambar*), a strange tropical representative. *Alangium begoniifolium, var. tomentosum*, characterized by its extremely rapid growth and the fact that in 15 years it has reached maturity and dies, is grown for poles by the planters. *Casuarina sumatrana*, the most beautiful of all the genus. *Musa glauca*, the strange seed-



ODD FRUITS FROM SIBOLANGIT

Figure 8

The strange fruits of the Asam Gloegur (*Garcinia atroviridis*), a relative of the mangosteen. The thick rind splits into segments of its own accord when the fruit is ripe. These are so sour that they make a lime seem sweet. They dry black and are much used in curreys. One-half natural size.

Seeds and a half pod, natural size, of the Giant orchid (*Grammatophyllum speciosum*). There are probably ten million seeds contained in one seed pod. Individual seeds are shown attached to the outside of the pod. They are scarcely visible to the naked eye. Sibolangit Plant Garden, Sumatra.

bearing banana. *Garcinia nervosa,* a giant leaved species, and a collection of great interest of 40 or so species of *Zingiberaceae* and about as many *Araceae,* a number of very handsome species.

I asked Mr. Loerzing how many species of plants, both wild and planted, he thought were represented in the garden and he replied from "2,500 to 3,000 species."

When one recalls that in the Flora of the British Isles there are estimated to be about 1,200 species and that only a comparatively small part of these are trees, whereas in this one jungle garden there are twice as many species and probably ten times as many trees, the true nature of the array of plant forms presented to one can be realized.

But as I read over this attempt to picture Sibolangit as we saw it in March of '26, I see that I have left out of it the setting of the tiny guest house beside the great highway to Brestagi. It is almost on the very edge of a marvellous forested cliff, where I often stood in the moonlight and watched through the fronds of the great tree ferns the shifting fairy-like haze below. Unbelievably romantic and wonderful does that little place seem to me as I look back on it. Sometime I want to return and stay until the hundreds of marvellous forms of plants become as familiar to my eyes as are those I live among in my Florida home.

Sibolangit lies 30 miles from Medan, the largest and most modern town in Sumatra. Medan is on the East Coast and can be reached either from Balawan, its port, where the splendid Dutch steamers call on their way to Java, or from Sabang, the little harbor off the North Coast of Sumatra where many steamers stop to coal on their way to and from China. If one goes to Singapore one can reach Medan in two days with ease by the beautiful and luxurious steamer *Plancius* of the K. P. M. line.

Since Sibolangit lies 500 meters above the sea in the cool zone, and has a rainfall of 156 inches, and is free from fever, having no mosquitoes to speak of, and no flies; it is as healthy a place to live as one can find perhaps anywhere in the tropical world.

May it be long maintained by the Dutch Government or the planters as a wild tropical garden to which botanists from the entire world may go for inspiration!

It lies within gunshot of rubber plantations which are making their owners millionaires. This Brazilian rubber tree was brought to Sumatra's shores by botanists and its culture urged upon practical planters by botanists, and it will be hard to believe that those whose fortunes have been made out of trees will begrudge the support necessary to keep these superb forest trees of Sibolangit from being cut down and destroyed.

The photographs reproduced in this article were taken by my friends P. H. Dorsett and J. H. Dorsett to whom I am indebted for the privilege of using them.

NOTE: Since this account was written I have received word of the closing of this marvellous garden by the Dutch Government, I presume because of lack of financial support. With the coming of air travel these unique places of the world will become of vast interest. Is there no way to prevent their destruction? —*D. F.*

Revision of Thomson's "Heredity"

HEREDITY, *by* J. ARTHUR THOMSON, 5th Edition, thoroughly revised. Pp. 542. R. V. Coleman, New York, 1926.

A readable book in which are to be found discussions of many aspects of heredity not found in the American elementary texts on this subject. The discussion of the important findings of many workers on chromosomes and on intersexes seems hardly up-to-date nor adequate. It can be heartily recommended however.

G. M. D.

"BIGHEAD" OF HORSES A HERITABLE DISEASE*

B. M. Gonzalez and Valente Villegas

College of Agriculture, University of the Philippines

THIS study deals with a peculiar disease of horses usually characterized by an enlarged face and jaws, commonly called "bighead." A number of authorities, principally of continental Europe, regard it as simply a form or symptom of rachitis or osteomalacia.[5] Without necessarily taking sides at this time in any controversy on the question as to whether or not it has any relation to the foregoing diseases, the present discussion confines itself to the bone affection found in horses, "which develops slowly and progressively and is characterized by the absorption of the calcareous or compact bony substance and the formation of enlarged, softened, and porous bone."[11]

Literature

The cause of this malady is not definitely known. Many theories have been advanced as to its etiology. Noorgard[12] in Hawaii, and others believe that it is due to deficiency of lime in the feeds. On the other hand Theiler[13] in South Africa states that it does not appear to be connected with the kind of feed used, and that the lack of bone-building salts cannot be considered as the cause of the disease.

Ingle[6] is of the opinion that the abnormal condition of the bones is induced by the use of foods not necessarily deficient in lime and phosphates, but in which the ratio of lime to phosphoric acid is too low. He suggests that some pathogenic organism may find such a condition in the animal favorable for its development.

Mohler[11] states that it has many of the characteristics of an infectious disease and that it appears to be due to a nitrifying organism which prevents assimilation of mineral salts. On the other hand, according to Theiler[13], blood transfusion experiments from diseased to normal horses fail to produce an infection. He suggests that the causative agent may be transmitted by an intermediate host, in the same manner as the tick in Texas fever.

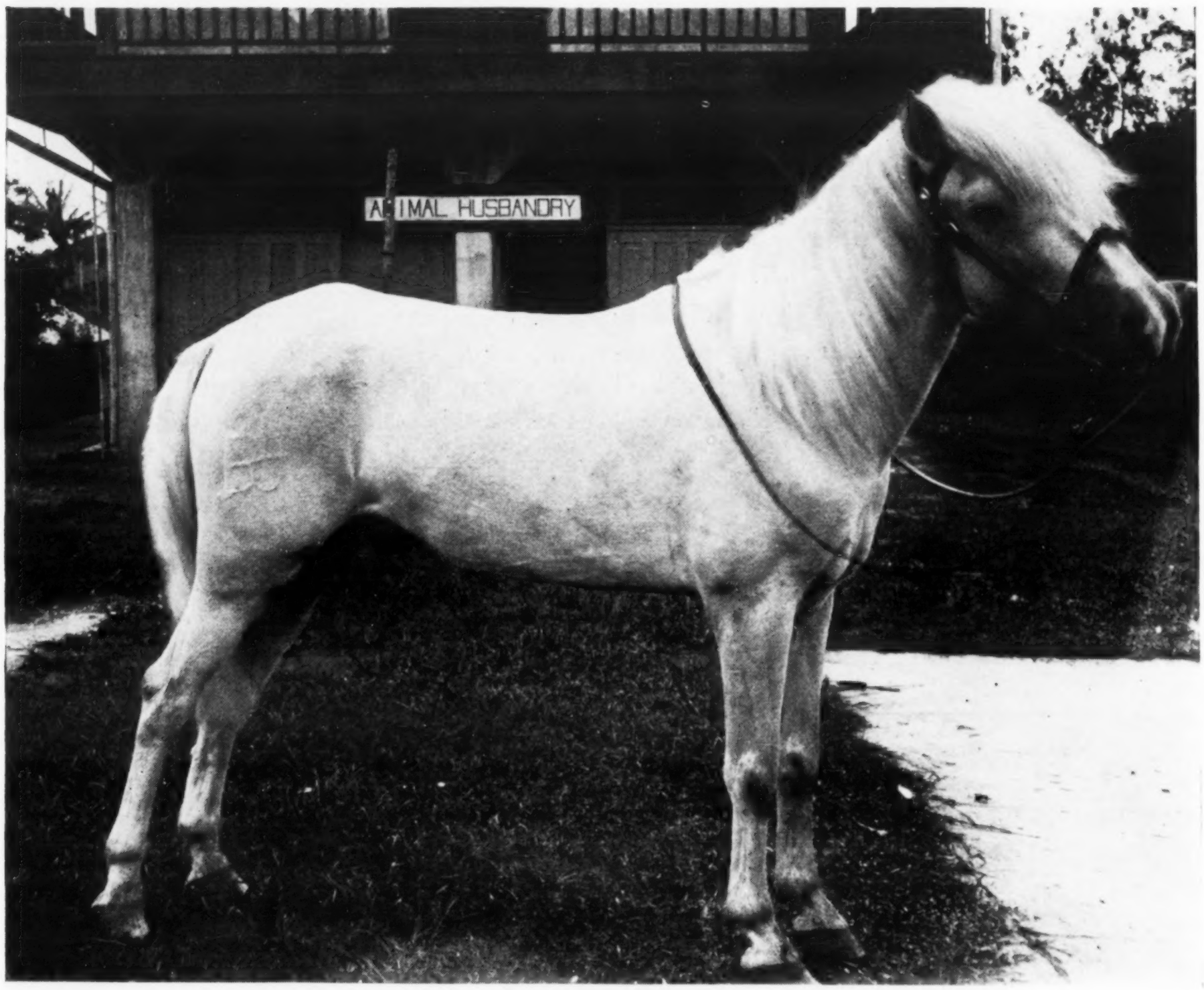
Mohler[11] quotes an experiment by Pearson in which a piece of bone from the diseased lower jaw of a colt was transplanted into a cavity made for it in the jaw of a normal horse without reproducing the disease.

Bitting[1] noted a number of cases in Florida. He finds little difference in susceptibility between native and imported stock. He regards the cause as unknown, the evidence of its contagiousness being inconclusive. Hutyra and Marek[5], however, state that imported horses are more susceptible than native born animals in countries where the disease is prevalent.

Conreur[3] in Brazil in a number of post-mortem examinations of animals suffering from "bighead" or "cara hinchada" found innumerable worms of the genus *Cylicostomum*. On the basis of this evidence he considers the disease to be of verminous origin and calls it Cylicostomiasis.

Koster[9] calls attention to the seeming frequency of cases of osteoporosis in the Philippines. He summarizes the present state of knowledge on the etiology of the disease and discusses the theories that have been advanced, the bases on which they were evolved, and the arguments for and against them

*Paper read June 23, 1927, before the Los Baños Biological Club.



SULTAN, THE PROGENITOR OF THE OSTEOPOROTIC STOCK

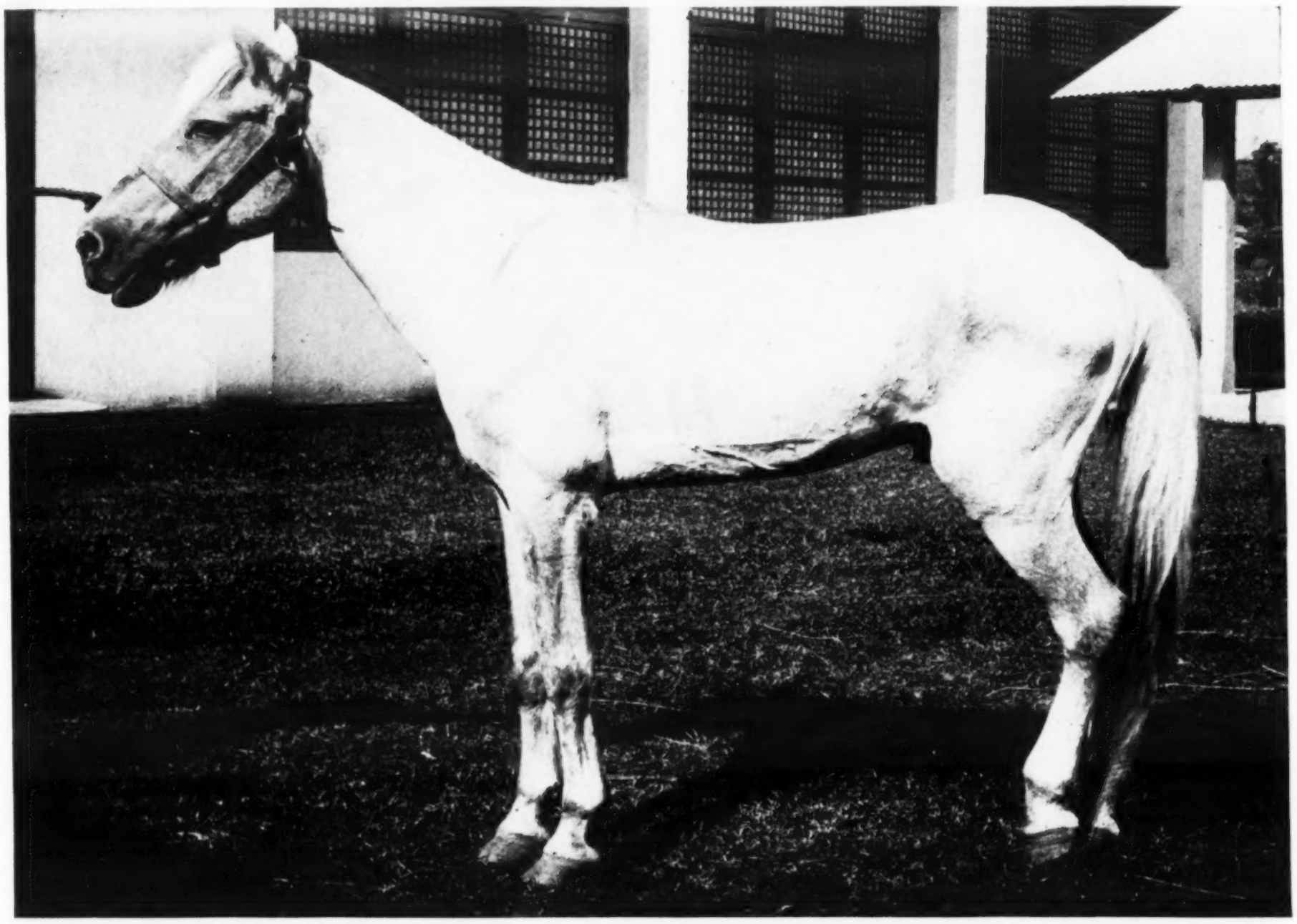
Figure 9

The nucleus of the experimental animals is Sultan. At the time of purchase he was a beautiful animal of excellent conformation and of fine mettle. His defects were that he had a steep sloping croup and was prone to rest one of his hind legs when standing.

under the following: (1) Deficiency of mineral content in the diet and water, (2) defective absorption of calcium, (3) acidosis, (4) infection, (5) toxemia, (6) lack of fat soluble vitamin, (7) disturbance of the ductless glands, and (8) hygienic surroundings and climatic conditions. While he believes some theories to be more tenable than others, he regards none as entirely satisfactory and pointedly asks "What is the cause of osteoporosis?

Bitting[3] states that "few facts could be obtained to determine whether the disease or a predisposition to the disease could be transmitted by heredity." Bordeaux[2] records some clinical experience at the Veterinary School of Melbourne University and states that " . . . . . whatever the exact cause of this bone disease in horses may be, two factors seem to have a very strong predisposing influence in its development, viz., inheritance and work." He relates his observations on six sires which produced a high percentage of offspring that suffered from obscure chronic lameness, which he was able to verify in a number of instances on post-mortem examination to be due to chronic rarefying ostitis and arthritis.

Huston and Bryan[4] in Indiana report that the bone of a normal horse is yellowish while that of the diseased



SULTAN IN LATER YEARS

Figure 10

When at the age of 11 years he suffered from apparent soreness of muscles or stiffness of joints. The diagnosis of more than one attending veterinarian was rheumatism.

is gray and brittle. An analysis of the humerus of each animal showed that the most conspicuous change in the bone of a horse suffering from osteoporosis is a reduction in the amount of fat, phosphoric acid, lime, soda, and nitrogen-free organic matter. On the other hand there was noticed a small gain of ossein. Ingle[7], analyzing bones of healthy and diseased horses, mules, and jacks in the Transvaal, concludes that the presence or absence of osteoporosis can be determined with certainty by the chemical composition of the bones. He corroborates in part the results of Huston and Bryan, stating that there is an actual deficiency of lime and phosphoric acid in the bones of horses suffering from osteoporosis.

Bitting[1] describes the symptoms and course of osteoporosis as follows:

> One of the first symptoms noticeable is the dropping of the croup. . . . . Following this is weakness of the back and enlargement of the bones of the face or lower jaw or of the shoulder. . . . The ribs gradually change so that a round-barreled horse becomes flat-sided, with a tendency to hang heavy below. The back becomes straight, and the younger the animal the greater the tendency to become elevated or arched. . . . .
>
> A peculiar lameness precedes or accompanies all the processes. The lameness comes on very suddenly, at first very difficult to locate, appearing at one time to be in one joint, and found in another when an examination is made. . . . . .
>
> The lameness ceases as quickly as it comes. The animal assumes a very peculiar gait. There is little shoulder movement, the steps are short, executed as if there was stiffness in all the joints; the hind legs are carried farther under the body than natural, thus giving the appearance of kidney trouble.

According to Mohler, if the long bones are involved, symptoms of rheumatism will be first observed,

while if the dorsal or lumbar vertebrae are affected indications of a strain of the lumbar region are in evidence.

Materials

The materials used in this study are mainly horses belonging to the Department of Animal Husbandry. A number of animals belonging to residents of Los Baños were included as need for them arose.

The nucleus of the experimental animals is Sultan, a native horse purchased from Lipa, Batangas, in 1917, for use as a breeding animal. At the time of purchase he was a beautiful animal of excellent conformation, and of fine mettle. His defects were that he had a steep sloping croup and was prone to rest one of his hind legs when standing. Sultan was used for breeding for a number of years without showing any noticeable physical defect which would impair his breeding ability. He suffered from a splint at one time, which readily subsided upon application of the firing iron. Considering that he was a highly spirited animal at the stable, he was always a slow performer on the road, with a way of going that was characteristically stilted in the hind legs. In later years, when at the age of 11 years, he suffered from apparent soreness of muscles or stiffness of joints. This was so acute at times that the animal could barely carry its weight. He evinced considerable difficulty in getting up and sometimes was unable to do so. The diagnosis of more than one attending veterinarian was rheumatism. He was therefore treated for this ailment for over two years and during this time showed no improvement that could reasonably be attributed to the treatment. The periods of acuteness were not persistent, but rather recurring. Observations showed that these acute periods were likely to occur from June to January, the cold, rainy months in this locality. No acute periods were observed from February to May, which are the dry, hot months. At no time did the animal show the swelling in the head and face characteristic of osteoporosis, although lack of appetite was a common symptom when lameness was most acute. An examination of the mouth and teeth at the time showed that they were apparently normal in every way.

The recurring lameness of Sultan, being more or less continuous throughout the year, excited our suspicion that this ailment was not rheumatism, and when in January 1924, one of his oldest offspring living, Sultan Junior, developed unmistakable signs of *bighead* when under intensive training in the race track, we thought of osteoporosis as the possible disease. From this time on regular observations of his behavior and that of his offspring were made and some experimental matings made. The results of these matings are given in detail below.

Briefly the plan of the experimental matings is:

(1) To mate normal mares with an osteoporotic stallion.

(2) To mate the same mares with non-osteoporotic stallions.

(3) To mate osteoporotic mares with a normal stallion.

(4) To mate osteoporotic mares with osteoporotic stallions.

1. *Mating normal mares with an osteoporotic stallion.* The animals listed below were produced under this type of mating:

Dam	*Sire*	*Get*	*Sex*	*Age*	*Remarks*
Mermaid	Sultan	Sultan Jr.	M	6 years 6 months	Osteoporotic
Mermaid	Sultan	Luck	M	3 years 8 months	Osteoporotic
Mermaid	Sultan Jr.	Sensation	F	2 years 10 months	Normal
Amazon	Sultan	Belle	F	7 years 9 months	Osteoporotic
Amazon	Sultan	Sultan 2nd	M	3 years 2 months	Blind
Reyes mare	Sultan	Castor	M	2 years 10 months	Osteoporotic

In the foregoing list five offspring were sired by Sultan, four of which were osteoporotic. The only animal sired by Sultan which is apparently non-osteoporotic developed a blindness, the cause of which is obscure. This animal was sold when only 1 year and 3 months old and we have no further information as to whether or not it developed "bighead." It is the suspicion of two veterinarians, Drs. San Augustin and Schultz, who examined it, and who were not aware of the study we were making that an enlargement of the nasal or turbinated bones may have pressed on the optic nerve thus paralyzing its functions.

The only animal in the foregoing list which to all appearances is normal was sired by Sultan, Jr., a get of Sultan.

If we may assume a dominant mendelian factor as the determiner for osteoporosis and represent it as *O* then its normal allelomorph would be *o*. In the above matings Sultan may provisionally be designated as *OO* and the normal mares *oo*. The mating is therefore:

OO × *oo* = *Oo* (all osteoporotic).

Inasmuch as the character *O* for osteoporosis transmits as a dominant character, any animal having this factor would show the disease. The observations show that all the offspring of Sultan developed osteoporosis, except one doubtful one. This theory conforms best with the observations. If Sultan in this respect represented a genotypic composition *Oo* we would expect 50 per cent of his offspring with normal mares to be osteoporotic and 50 per cent sound, which is far from the facts as noted.

Sultan Jr. being sired by Sultan out of a normal mare, his genetic constitution would be *Oo*. Mating him with normal mares we would produce:

♂ *Oo* × ♀ *oo* = 1 *Oo* : 1 *oo*,

or 50 per cent osteoporotic and 50 per cent sound. The production of a normal offspring like Sensation is a 50 per cent possibility, therefore, in this type of mating.

2. *Mating the normal mares used in (1) with normal stallions.* This mating was made to test the behavior of the mares which produced osteoporotic offspring by an osteoporotic stallion, when bred to a normal stallion. The animals shown below were produced under this type of mating.

It is evident from the normal progeny that the mares were in no wise responsible for the production of osteoporotic offspring. The matings may be represented as:

♂ *oo* × ♀ *oo* = *oo* (all normal).

The offspring produced under this type of mating were all normal.

3. *Mating osteoporotic mares with a normal stallion.* So far only one mating has been done under this experiment. Belle out of Amazon by Sultan developed osteoporosis. In accordance with our theory her genetic make up is *Oo*. So far she is the only female to develop osteoporosis. When mated to a normal stallion she produced a male offspring which developed the disease at an age of one year and ten months. This animal is a grandson of Sultan. This mating is of this type:

♂ *oo* × ♀ *Oo* = 1 *Oo* : 1 *oo*

(1 osteoporotic to 1 normal).

There is therefore an even chance of producing normal and osteoporotic individuals from this type of mating.

Type 2 Matings (Normal x Normal)

Dam	*Sire*	*Get*	*Sex*	*Age*	*Remarks*
Mermaid	Arana's Horse	Petite	F	5 years 3 months	Normal
Mermaid	Hassan	Prince	M	1 year 9 months	Normal
Amazon	Dean Baker's Horse	Summer	F	4 years 1 month	Normal
Amazon	Hassan	Lady	F	2 years 3 months	Normal
Amazon	Hassan	Duchess	F	1 year	Normal
Reyes Mare	Villegas Horse	Castaña	F	4 years 1 month	Normal
Reyes Mare	Hassan	Zamora	F	1 year 1 month	Normal

4. *Mating osteoporotic mares with osteoporotic stallions.* Only one actual mating has yet been made of this type, and the offspring is still unborn. Depending on the genetic composition of the parents, these matings are possible:

♂ *OO* × ♀ *OO* = *OO*
(all osteoporotic).

♂ *OO* × ♀ *Oo* = 1 *OO* : 1 *Oo*
(all osteoporotic).

♂ *Oo* × ♀ *Oo* = 1 *OO* : 2 *Oo* : 1 *oo* (75 per cent osteoporotic).

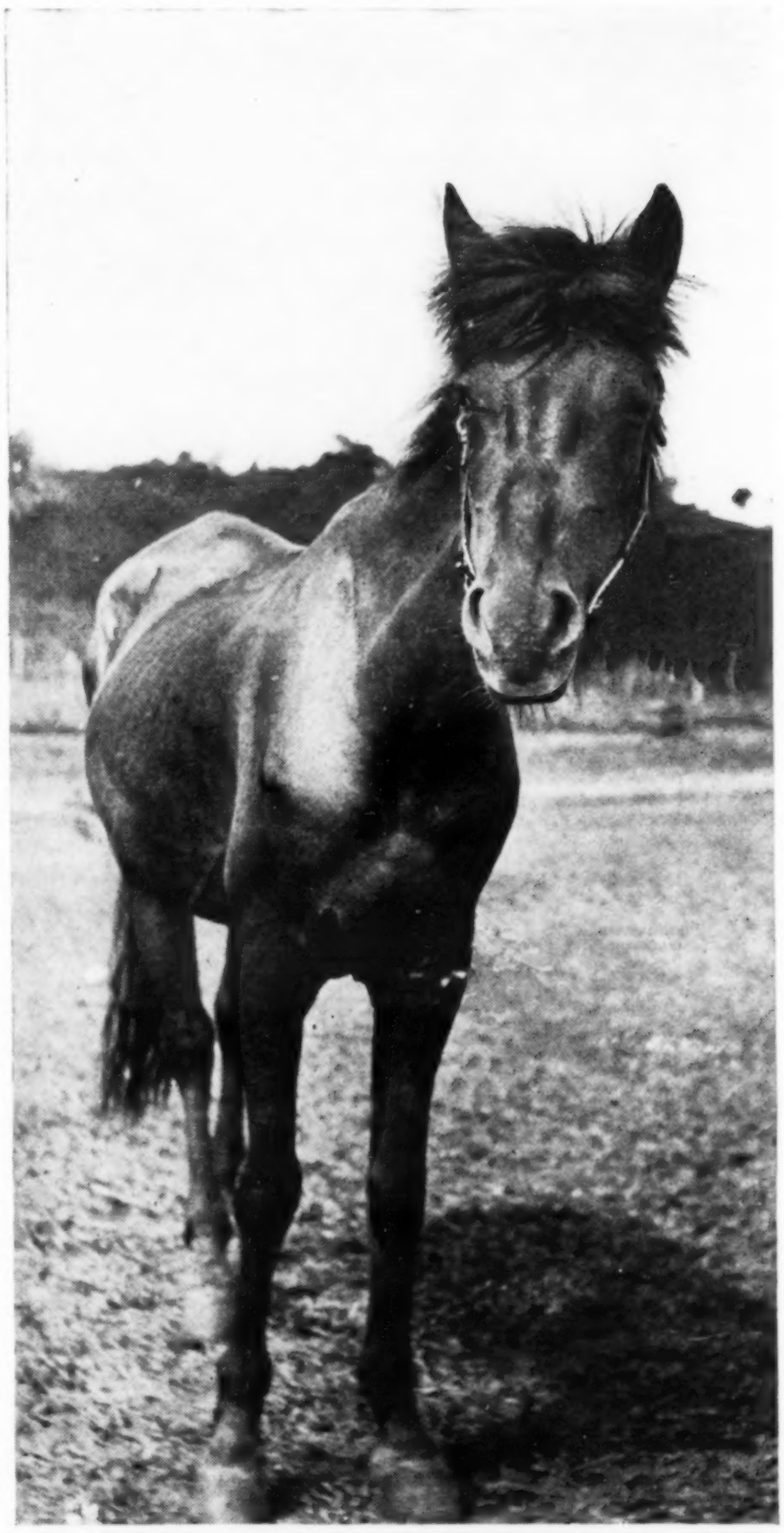
♂ *Oo* × ♀ *OO* = 1 *OO* : 1 *Oo*
(all osteoporotic).

The data being fairly consistent with the theory in the first three types of matings, there seems to be little justification in carrying on many matings of the fourth type from the point of view of expense. As a purely scientific objective it will of course be interesting.

Clinical Symptoms of Osteoporosis

Based on gross anatomical observations, the symptoms of osteoporosis may be localized in the head and in the legs. Both forms of affection may be present in an animal.

Osteoporosis in the head. According to our observations, the first indication of osteoporosis in the head of a horse is the appearance of a bony enlargement on both sides of the face below the eyes, accompanied by general lack of appetite and languid disposition of the animal. The swelling may start as a slight protrusion, later on becoming more distended. In very acute cases the patient manifests very little desire for feed, particularly grains, leading to rapid emaciation. This condition may last for weeks, varying with different individuals. Later on, as the swelling on the face increases in size and extent, the lower part of the jawbones also enlarges so that the space between them becomes narrower as the malady advances. At this time the nasal opening may become constricted and a wheezing sound is heard as the animal breathes.



BELLE, BY SULTAN

Figure 11

She is the only female to develop osteoporosis. When mated to a normal stallion she produced a male offspring which developed the disease, a grandson of Sultan.

Following the acute stage, the animal again feeds well and slowly takes on flesh, but the swellings on the face and jawbones linger for some time, gradually subsiding to normal but at a very slow rate.

In some individuals the leg form may show up simultaneously with the head osteoporosis.

Osteoporosis in the legs. This form of osteoporosis affects both hind legs only, rendering the animal lame on one

LUCK, BY SULTAN

Figure 12

He developed osteoporosis when 1 year 4 months of age. All the offspring of Sultan developed osteoporosis, except one doubtful case, which became blind, probably resulting from an obscure form of osteoporosis.

or both members. In some cases shifting lameness may be observed, in which one leg may become lame and recover to be followed by the other. In the mild form of leg osteoporosis the gait of the horse is normal, except for the stilted action of the hind legs, causing the pace to be short and broken in cadence when the animal is exerted to move faster. In the acute stage, the animal suffers pain in the legs and finds difficulty in moving around, particularly in getting up from a recumbent position. The appetite is also impaired. Consequently, the animal runs down in health and becomes greatly emaciated more so than in the acute stage of head osteoporosis. In severe cases, the legs may become swollen.

If the animal is properly attended to as to feeding, rest, and care, particularly as to the quality of feed, sanitary condition of the stable and plentiful supply of bedding, to prevent the onset of other ailments, lameness may disappear within a few weeks, accompanied by a resumption and improvement of appetite and in the health and condition of the animal. If the legs are swollen this may subside as lameness disappears.

It would appear from the materials used in the present study that the absence of facial enlargement is a comparatively rare feature of this disease, for all animals reported as suffering from osteoporosis had symptoms of *bighead* but the ability of an animal not having this symptom to transmit this form of disease to its offspring is in no wise affected.

Age of Animal When Disease Appears

There seems to be no definite age when the disease makes its symptoms apparent. The data on hand indicate that this may vary from as early as 1 year 4 months to 4 years 8 months. Animals younger than one year do not exhibit any symptoms as a rule and normal animals beyond five years are likely to remain so. The ages of the animals when obvious symptoms of osteoporosis were observed are given below. In all cases "bighead" was the principal symptom upon which diagnosis was based.

Subject	*Sex*	*Age when first symptoms were noticed*
Sultan Jr.	M	3 years 2 months
Luck	M	1 year 4 months
Belle	F	4 years 8 months
Castor	M	2 years 7 months
Earl	M	1 year 10 months

Three other offspring form part of this experiment but due to the fact that they are under one year old, they can not be considered in the present report.

Discussion

It is evident from the results of this experiment that osteoporosis is an inherited disease, in much the same manner as feeble-mindedness, myopia diabetes mellitus, etc., are in humans.

In a manner similar to the foregoing diseases, it is possible that some organ or organ system of the body fails to function normally inducing the abnormal formation or actual destruction of bone tissue through the accumulation of toxic by-products of metabolism. It seems to us that research should be directed towards the localization of the failing organ, and that the blood and the urine may give a clue as to which particular organ is implicated. We pass this suggestion on to our colleagues, the veterinarians.

Any line of treatment that may be suggested for a hereditary disease would simply be in the nature of a palliative. Because of its being a dominant character, the control of the disease by preventive methods is fortunately considerably easier than in the case of the above-named diseases in humans. It is obvious that no diseased animal should be allowed to breed, and sterilization of afflicted individuals readily commends itself.

Proper feed and work may improve conditions somewhat although they should not be regarded as direct causes on this account. If the first were the cause, animals in the same stable and consuming the same feed would fall equally victims to the malady. Work may readily be imagined as stimulating to the progress of the disease. A diseased part will naturally break down quicker than a sound one when under strain. The justification for existence of an osterporotic horse will depend largely on the work demanded and the severity of its affliction.

If a negative fact may be taken as an indication, it is evident that the disease is not contagious. Most of the horses used in this experiment have been herded together all their lives, yet not all of them developed the disease. If there is an intermediate host, as has been suggested, it did not attack the animals uniformly. Perforce, the assumption must be that the intermediate host exists in our locality, if we are to accept this theory at all, as the disease exists in a number of individuals in our stables. By the same token we have to dismiss the feed as a cause, for all our animals receive identical feeds.

Another horse used for public breeding and suffering from osteoporosis has come to our notice. This one had an enlarged head and was later withdrawn from use as he was unable to mount on the mares, apparently because of the pain in the hocks, and possibly other joints. Two offspring of this stallion came to our observation, one was sound while the other was osteoporotic.

Summary and Conclusions

1. The data here presented demonstrate beyond reasonable doubt that osteoporosis is a constitutional disease which is heritable.

2. A provisional hypothesis is put forth that it is a simple dominant non-sex-linked mendelian character.

3. The theory is advanced that the disease is caused by the failure of an organ or organ system to function properly.

4. Control measures directed toward the prevention of breeding of affected individuals are recommended.

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The Origin of Cultivated Plants

Origin of Cultivated Plants, *by* N. Vavilov. Publication of the Bureau of Applied Botany. Pp. 248, including an English Abstract of 110 pages. Leningrad, 1926.

Vavilov has shown us a new side to an old story. Instead of theorizing at his desk in Leningrad (where fuel may have been scarce) he started out over the world to see what story the plants would tell of their own origin. He and his assistants wandered through Persia, Transcaucasia, Bokhara and Afghanistan. Pisareff covered 5,000 miles on horseback in Mongolia. In addition to the work of his own staff Vavilov took pains to find out what others were doing. His insistent inquiries to his friends over the world was almost an inquisition. From all of this searching there slowly assumed form a census of plant variation. In many cases this census needed no elucidation. In others the explanation is yet to be found. Usually definite centers of diversity were apparent. Regions of maximum diversity, commonly including also a series of endemic forms and characters, were taken to be the centers of origin. In the most convincing cases these were characterized by the greatest number of varieties and the greatest number of morphological and physiological characters. As one passed from the center in any direction the number of varieties and the number of characters decreased. The greatest diversity of specialized parasites were expected and found in the centers of origin of the hosts.

Soft and club wheats are thought by Vavilov to have originated in the mountainous districts of southwestern Asia. From Afghanistan to Kashmir there is a great abundance of these forms. The situation with durums is quite otherwise. Afghanistan, so rich in soft wheats, contains no durums. The great diversity of durum wheats is found about the Mediterranean. North Africa exhibits not only a large number of forms of durum wheat, but also of the near relatives, turgidum and polonicum wheats.

Abyssinia is rich in endemic forms of *turgidum* and *durum* as well as *dicoccum*. The varieties of emmer, however, are thought now to represent the remnant of a once greater diversity. The cultivation is principally limited to more or less primitive peoples in Africa, Europe and Asia.

The centers of cultivated barley are not explained by the conception of a single source. There is a very definite center in southwest Asia and a second in Abyssinia. There is also a group in southeastern Asia. The only large seeded wild barley (*H. spontaneum*) is

not a plausible ancestor of any considerable number of cultivated barleys and may be the parent of none.

In oats Vavilov sees a cereal all stages of which are still in existence. It is a standard grain in some places, a half utilized plant in others, and a weed in grain fields in still others. Oats are rather new in agriculture and in many parts of the world they are still weeds. Several independent centers or origin are apparent. forms of *Avena byzantina* are distributed about the Mediterranean particularly in North Africa. The *strigosa* group is found mostly in northwestern and western Europe. *A. sativa*, on the other hand, is much more widely distributed. Once ascribed to Europe, its origin is made doubtful by the finding of endemic forms as far away as China. The genetically related *A. nuda* is found in great diversity only in China.

Millet (*Panicum milaceum*) is unquestionably Asiatic in origin, probably from the hills of Mongolia.

India and Afghanistan show the greatest diversity in flax. Yet a region of so great diversity as India does not contain nearly all forms of flax. Endemic forms are found in Bokhara and in northern Africa.

The compilation of information in this work of Vavilov's is enormous, covering crops and phases not mentioned here. The notes that I have made are merely for the purpose of calling attention to his method. While the publication contains more than 100 pages, it shows many evidences of condensation and the reader very frequently wishes that particular statements might have been amplified. Vavilov, however, has given us very much and it is, perhaps, ungrateful to wish for more.

H. V. Harlan.

Sex in Plants

BESTIMMUNG, VERERBURG UND VERTEILUNG DES GESCHLECHTES BEI DEN HOEHEREN PFLANZEN, By C. CORRENS. Handbuch der Vererbungswissenschaften edited by E. Baur and M. Hartmann, Part 3. 19.20 marks. Gebrüder Borntraeger, Berlin, 1928.

This issue of the new "Handbuch" will be very welcome to everyone interested in the problems of the inheritance of sex and the mechanism of sex determination and sex distribution in plants. No detailed digest of this field has been published within recent years, and nobody could have been better equipped for this task than Correns who has done so much of the fundamental work in this domain. Throughout his contribution Correns confines himself to a critical and exhaustive report of the facts established by experimental analysis, and he consciously leaves the theoretical evaluation to a time when the principal processes governing sex determination and sex inheritance in plants will be better understood. The author's efforts to employ an appropriate terminology should prove particularly valuable.

W. L.

RELIGION AND FAMILY SIZE

Composition of Families in Different Religious Denominations in Tallahassee, Florida

ROLAND M. HARPER

ONE occasionally reads in some newspaper that a religious census of a certain city is to be taken soon by volunteer workers from the several churches; but the results of such investigations are seldom published, or if they are, there is usually little more than a mere statement of the number of members of different denominations, such as the United States Census Bureau gives every ten years or so for counties and larger cities.

About three years ago the writer undertook a religious census of a very different sort for Tallahassee, with the primary object of getting some light on the supposed dying out of old families in the South. Before describing the methods and results a brief description of the social conditions of the city will be in order.

Environment

Tallahassee has been the capital of Florida ever since early territorial days, having been selected as such in 1824, partly on account of being approximately equidistant from the two principal settlements of that time, St. Augustine and Pensacola, and partly on account of its attractive surroundings. It is also the county-seat of Leon County, which was established in the same year. It has always been the largest city in Middle Florida.

It is about 16 miles from the Georgia line and 25 miles from the Gulf of Mexico. The center of the city is on a hill about 120 feet above the nearest stream and 200 feet above sea-level. The surrounding country, especially northward, is made up mostly of red clay hills, interspersed with lakes of various sizes (apparently the only region in the United States where that combination of scenery occurs). The soil is just about the most fertile in Florida, and before the Civil War this hill country was mostly occupied by large prosperous plantations, with many slaves. Even yet there are many more negroes than whites in the county, and on some of the roads radiating from Tallahassee one can go several miles without seeing a white man's house.

When the seat of government was located here there were no inhabitants except Indians, but the state business together with the fertile soil soon caused a thriving community to develop. The sources of the settlers can be inferred approximately from the fact that in 1880, of the 19,662 inhabitants of Leon County, 15,154 were born in Florida, 1,826 in Georgia, 852 in North Carolina, 517 in Virginia, 439 in South Carolina, and 204 in Alabama. But if we had separate figures for whites, adults, for Tallahassee, and for two or three decades earlier, the proportion of natives of other states would doubtless show up much larger. Tallahassee had 1,616 inhabitants in 1840, 1,932 in 1860, 2,494 in 1880, 2,981 in 1900, and 5,637 in 1920. Whites were slightly in the majority up to 1860, but after that negroes predominated in the population of the city until about 1919, when the whites again took the lead.

Tallahassee is a little too far north to have shared appreciably in any of the Florida winter resort booms, except that as the population of the state increases more employees are needed at the capital to handle its business. Since 1905 it has been the seat of the State College for Women (which superseded an earlier college for both sexes on the same site), and the attendance of that, as at nearly all other colleges, has increased rapidly in recent

years, thus making business for more and more local merchants.

The state census of 1925 gave Tallahassee 6,415 inhabitants, but a more careful canvass made by the city authorities immediately afterward showed that more than ten per cent of the population within the city limits had been overlooked, and the approximate true figure should have been 7,173. The city was only one and a half miles square, and there were many people living just outside, making a community of approximately 10,000 persons.*

The growth of the city has been just about counterbalanced by a decline in the surrounding rural population (as is many other fertile regions), so that the population of the whole county was practically stationary from 1880 to 1925.

The prosperous planters in the surrounding country made Tallahassee the seat of considerable culture in antebellum days, and at the present time the College for Women, with over 1,000 students and nearly 100 faculty members, has a similar influence. Like many other cultured communities, the city has long had more adults than children and more women than men. But the establishment of some woodworking industries and other lines of manufacturing in the last few years has lowered the quality of the population a little. This was commented on in a recent Florida guide-book† as follows:

> Until a few years ago it was a delightful old Southern town situated on a hill, with beautiful shaded roads and fine old houses shut off from the road by shrubbery and vines. It has recently been hit by the Florida boom and has acquired real estate additions, paved streets, and sidewalks, so that it has lost much of its former charm.

Statistical evidence of the same deterioration is afforded by the fact that the percentage of persons under ten years old in the white population increased from 18.0 in 1910 to 19.4 in 1920 (while it was decreasing from 25.4 to 22.8 in the whole state and 21.8 to 21.6 in the whole United States), and the per cent of illiterates among persons over 10 increased in the same decade from 0.14 to 1.32 in the white population and from 14.6 to 25.9 in the negro population. The state census of 1925 did not give illiteracy statistics and the number of persons under and over ten for cities, but the adult percentage in Tallahassee decreased from 60.9 in 1920 to 59.2 in 1925, among the whites, and from 62.5 to 58.4 among the negroes, while it was increasing in the state as a whole, and probably in the rest of the United States (for the progress of medical science in increasing the expectation of life is bound to increase the proportion of adults).

The latest available federal religious census, that of 1916, did not give separate figures for cities as small as Tallahassee, but in that year about 40 per cent of the whites and 30 per cent of the negroes in Leon County were church members. The leading white denominations were Baptist, Methodist, Presbyterian and Episcopalian, as in most other parts of the South.

Religious Census

If the aristocratic families in the South are dying out, since the Civil War broke up the old plantations and drove their owners to the cities (where the birth-rate is nearly always lower than in the rural districts), they should now have a considerable excess of adults over children. No census in this country gives adequate data about different strata of society, but it occurred to me that if I could get separate figures in the matter of age distribution for the most and least aristocratic religious denominations, that would show at once if any such tendency existed. Accordingly, in January, 1925, I began jotting down the number of men, wo-

*There has been considerable growth since 1925, and the city limits were extended in 1927, but this article deals with 1925 conditions.

†"Going to Florida?" by Frank M. Dunbaugh, Jr, 16mo, 220 pp. New York, 1925. Quotation from page 66.

men and children in all the families I knew in the four leading white denominations in Tallahassee. Men and women were defined as persons over 21, and children those under 21. Unrelated boarders were not counted, but sons and daughters away at college were. In cases where the husband was a church member and the wife or some of the children not, or vice versa, the whole family was counted with the denomination to which some or most of them belonged. But families divided between different denominations were not counted.

Shortly after beginning this investigation I was called upon to supervise the state census, which occupied me for several months, and I did not get at Tallahassee religious census again until 1926. I then obtained the assistance of a few friends in each of the denominations in question, who were better acquainted than I was, to make the lists more complete. But all families were referred to their 1925 status, to make the figures comparable with the state census. I had hoped by this time to make similar studies in one or two other southern cities of about the same size, to see how they compared with Tallahassee, but have not had such an opportunity yet. The results for this one city are therefore presented, with the suggestion that any one who is sufficiently interested and acquainted can easily do the same thing in his own community; and it would be well to repeat the work every decade or so, to see what changes, if any, are taking place.

Completeness was not attempted, but my count covers over 200 families and over 900 individuals (not less than 100 in any one denomination), which must be nearly half the white church members in Tallahassee at the time the work was begun. And an absolutely complete count might change the ratios very little. In picking out the families in each denomination a telephone book was sometimes used to assist my collaborators in recalling the names, so that it is possible that some of the poorer members of all denominations, and some living outside the city limits have been overlooked, which would be likely to affect the ratios somewhat.*

To avoid possible offense to the members of any of these denominations, which may not make the best possible showing in one thing or another, they will not be named here, but will be designated A, B, C and D. Disregarding a few minor sects, A is the most aristocratic denomination in Tallahassee, and probably also the smallest, while D represents the other extreme; though no doubt some individuals in D are superior in every way to some in A. D happens to have the finest church building in the city at the present time (completed in 1915), made possible by its large membership. Throughout the South A and B have their greatest strength in cities, and C and D in the rural districts. A is a united church throughout the country, while B, C and D have northern and southern and white and negro branches.

The data collected for these four denominations are first the number of persons per family, and the same for men, women and children separately. Then the percentage of adults and the ratio of women to men and of children to women. A column is added for the average of all four denominations. The results are presented in Table I.

It will be seen at once that in most of these ratios there is a regular graduation up or down from A to D. The averages for all four combined are pretty close to the corresponding figures for the white population of the whole city. The families are smaller than the 1920 census indicates (there are no statistics of families for 1925), but that may be due partly to the use of the telephone book in picking out the

*When I was getting information about the members of the church hereinafter designated as "D," from a charming lady of that faith, she reached for the telephone book to assist her memory, and after scanning the first page or two exclaimed: "Well, haven't any of the D——— got phones?" But she ultimately described about fifty families for me, most of them represented in the book.

names, and partly to the fact that a family as defined by the census includes boarders, who are rather numerous in Tallahassee (as in many other cities).

The excess of women over men has little or nothing to do with the fact that most churches in the United States have more feminine than masculine members, for whole families have been counted in every case. It merely indicates that there is a surplus of women in Tallahassee, and especially in the more cultured circles.* The most aristocratic denomination has the greatest excess of women, showing that it is farthest removed from the social conditions prevailing in lumber and turpentine camps, cattle ranches, etc.

In communities where the number of women and children is equal the number of births and deaths is usually also about equal. According to this each of the four denominations in question still has a fairly safe margin, but the rate of natural increase is evidently least in A, and B, too, is below the United States average in that respect.†

State Census Statistics

It may be appropriate to add as a sort of corollary some statistics of Tallahassee taken from the 1925 state census, and not obtainable in such detail from any previous census. They cannot be correlated directly with the religious denominations, but they show some interesting differences between different quarters of the city.

The city is divided into four voting precincts, numbered 12, 13, 20 and 21, and it is possible to calculate for each the racial composition and the percentage of adults for each race. Number 12 includes church A and probably most of its members, and is the chief residential section, with the best paved streets. (Churches B and C are on the street which separates Precincts 12 and 13, and perhaps have as many members in one as in the other.) Number 13 includes the capitol, and most of the stores, as well as church D. Number 20 includes the college and most of its faculty members, but also the depot and many negroes. Number 21 ("Frenchtown") is occupied almost entirely by negroes and poor whites, and has no paved streets.

The results are shown in Table II.

The percentage of adults in the white population of the whole city is a little greater than that shown in the table for four denominations, presumably because the census includes a considerable number of boarders (nearly all adults) who were not counted in my religious census.

Although Precinct 12 seems to be the

TABLE I—Composition of Families in the Four Leading White Denominations in Tallahassee, 1925

	A	B	C	D	Total
Persons per family	3.92	4.07	4.14	4.21	4.10
Men	.90	.97	1.02	.97	.97
Women	1.35	1.37	1.28	1.16	1.28
Children	1.67	1.77	1.84	2.07	1.85
Percent adults	57.5	56.5	53.0	50.9	54.9
Ratio of women to men	1.50	1.46	1.26	1.18	1.31
Ratio of children to women	1.23	1.29	1.44	1.79	1.45

*Another bit of evidence bearing on the same point is that among the families of my acquaintance in various parts of the United States which have both sons and daughters, all of marriageable age, a larger proportion of the sons than of the daughters is married. (Many who read this will doubtless have observed the same tendency.) This seems to indicate an excess of females in educated families. I have also noticed recently that in several different states the counties which have produced the most "Who's Who" people in proportion to population nearly all have more women than men in their present population.

†The ratio of children to women in the white population of the United States decreased from 2.38 in 1850 to 1.49 in 1920, and in the latter year it was 1.22 in cities of over 2500 inhabitants and 1.87 in the "rural" territory or rest of the country. (It ranged from about 0.6 in a few winter resorts and college towns to over 3 in some rather primitive communities.) See May, 1927, number of this Journal.

most aristocratic, the proportion of adults is higher in 13, perhaps on account of some men living alone over the stores, and some families of adults living in hotels. Number 20, which includes the college, is also high in adults. The poverty of 21 is shown by the fact that it has the smallest adult percentages for both races. But even there the negroes have more adults than children, probably because their birth-rate is low in cities everywhere. (In the rest of the county no rural precinct has as many as 50 per cent of adults among the negroes, and one of them has only 38.1 per cent if the census figures are correct.) Among the rural whites the percentage of adults ranges from 34.1 in the sandy southeastern corner of the county to 57.5 in one of the red hill precincts adjoining the city.

TABLE 2—Racial composition and age distribution of the population of Tallahassee in 1925, by precincts:

Precincts	Percent whites	Percent of adults	
		White	Negro
12	76.6	58.6	56.8
13	73.0	60.9	59.6
20	48.7	59.9	63.4
21	8.6	41.0	55.3
Whole city	53.5	59.2	58.4
Whole county	36.1	53.7	47.7
Whole state	68.0	56.5	55.0
Whole U. S. (1920)	89.7	58.1	52.8

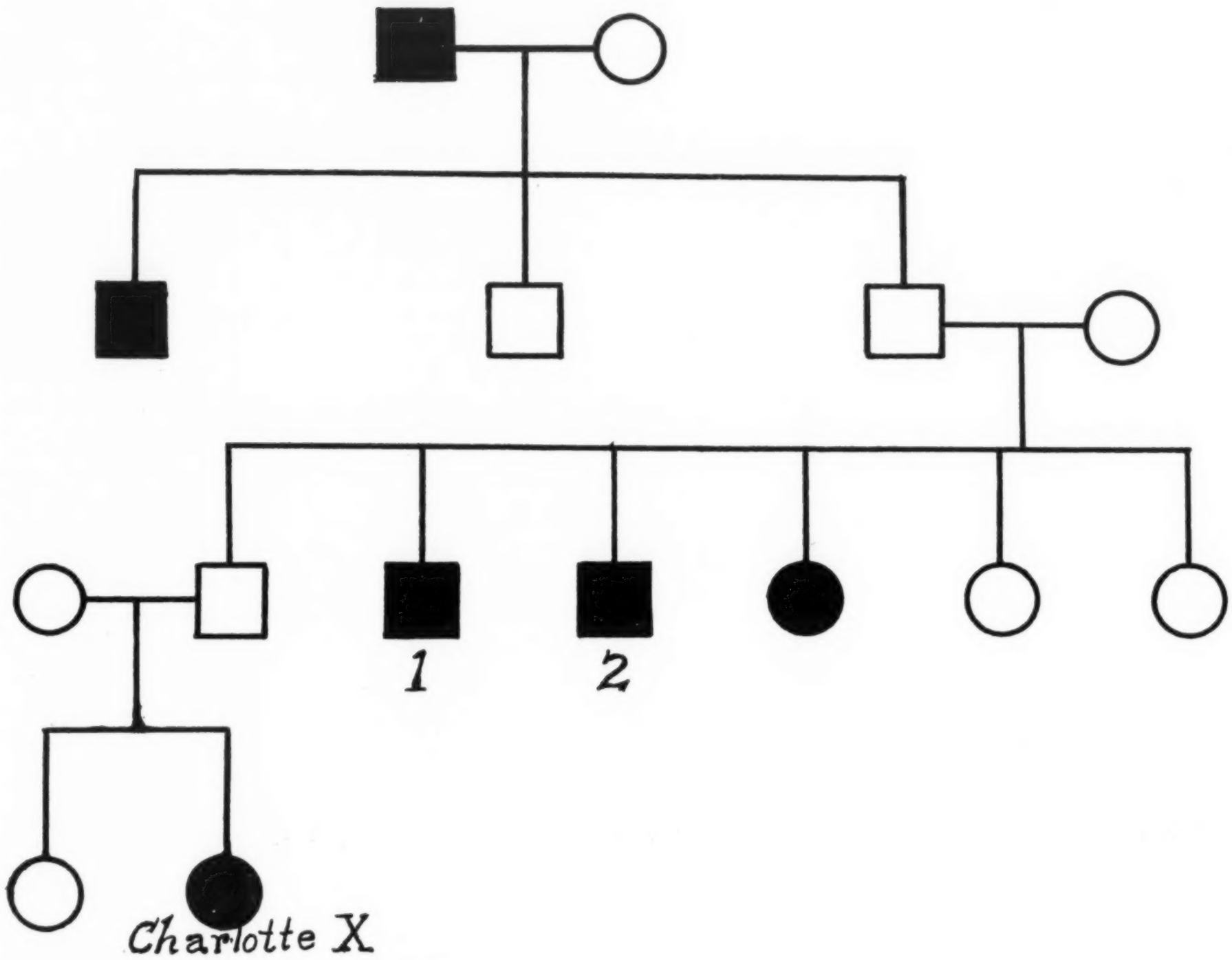
The Quest for Unity

PRIMITIVE MAN: HIS ESSENTIAL QUEST, *by* JOHN MURPHY. Pp. 341. Price, $5.00. Oxford University Press, American Branch, New York, 1927.

THE author sets out to give a psychological interpretation of the human mind's quest for unity as exemplified in primitive thought and religion. The enterprise is a worthy one, but one that calls for delicate and cautious handling. Psychological interpretation is so apt to fade off into ingenious but scientifically valueless psychologizing.

Interpreting the facts of cultural anthropology in the light of the facts of its sister science of psychology presupposes familiarity with the pertinent data of both sciences. So far as the facts of cultural anthropology are concerned, the author draws his data and theories almost exclusively from one wing of English anthropology, to the neglect of the American and German schools. He accepts, for instance, the pre-animistic theory of religious origins and the primitivity of totemism as established, notwithstanding the highly speculative nature of these two theories and notwithstanding the multitude of known facts that conflict with them. So far as psychology is concerned, he avoids it is true the extravagances of the French sociological school, but on the other hand he accepts as if obvious the very questionable key theory that the image-percept and the image-concept differ only in degree and that the latter has developed out of the former. He does not seem to be aware of the significant recent German and American experimental evidence upon the relationship of image and meaning.

Dr. Murphy, in endeavoring to trace out the main lines of man's prehistoric quest for unity, has simplified his own quest by leaving out of count fifty per cent or more of the most important facts. As a result, although there are some very suggestive pages in the book, his work on the whole can hardly be called a contribution to either psychological or anthropological science. *John W. Cooper.*



The Occurrence of a Skin Papillus through Four Human Generations

Figure 13

CHARLOTTE X————, age three, has a papillus of skin about .4 centimeters in diameter just in front of the external meatus of the left ear. From the parents I learned that this identical type of papillus has been present congenitally in the same location, just anterior to the meatus of the left ear, through four generations of the family. The accompanying diagram shows its occurrence. The papillus is not pigmented nor covered with hair, but has the appearance of normal skin. I am told by the parents of Charlotte its appearance has been the same in each generation.

The uncle of Charlotte, indicated by the number "1," had the papillus removed during childhood by his mother, who cut it off with a silk thread, but it recurred and grew to the size of the end joint of the little finger. The uncle indicated by the number "2" had the papillus sucessfully removed by a physician.

The papillus is apparently a simple inherited character. It is obviously not a Mendelian dominant nor a sex-linked character, but the diagram suggests it is probably a Mendelian recessive.

RICHARD JENKINS,
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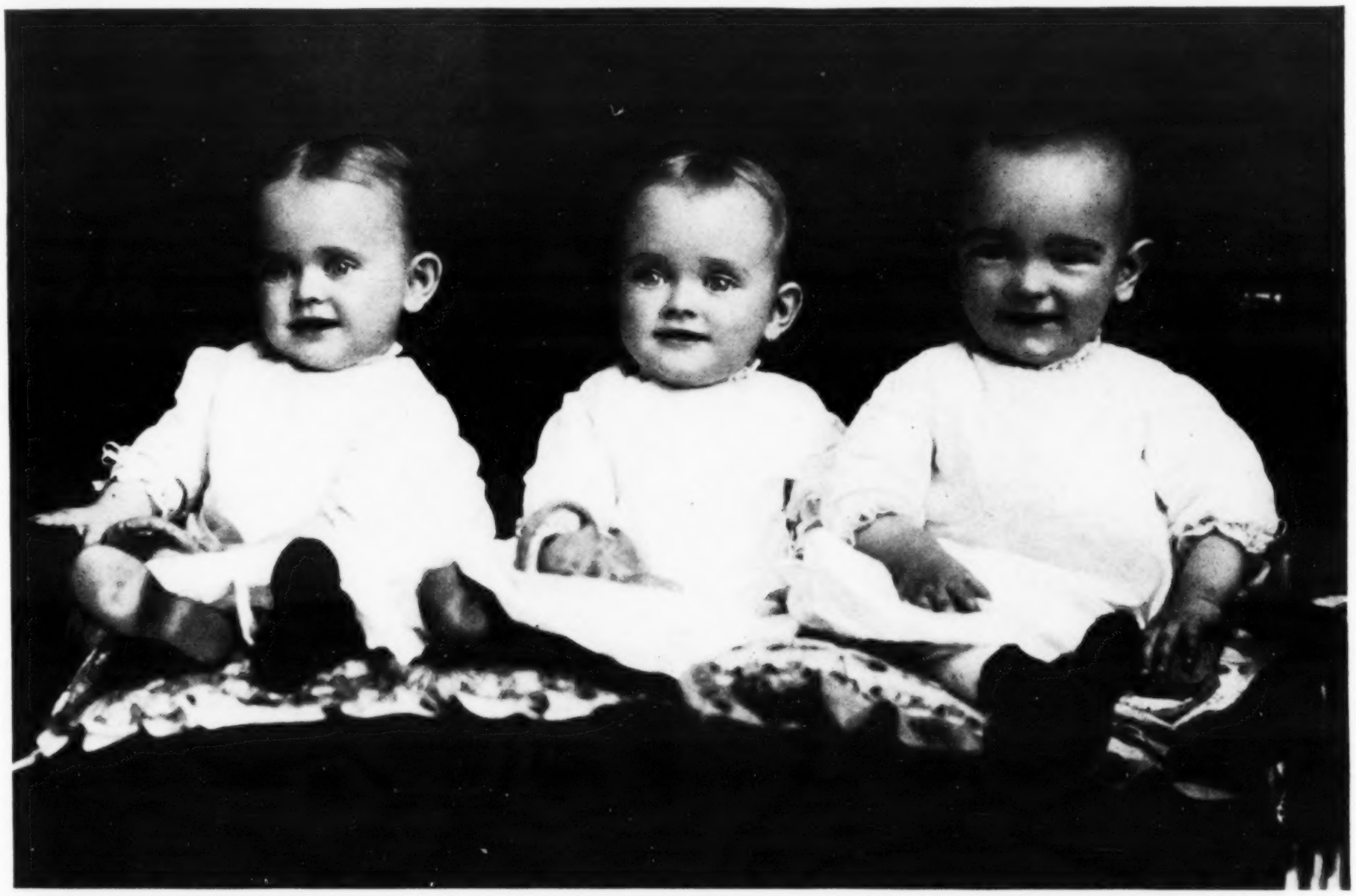
THE RESEMBLANCE OF TRIPLETS

E. C. Rowe,
State Normal School, Mt. Pleasant, Mich.



Clarice Phyllis Maurice

AT FIFTEEN MONTHS

Figure 14

The two girls are so much alike as to suggest they are identical. It would be a matter of interest to learn how great the probability of identity would be in terms of the methods described in earlier numbers of the Journal for differentiating fraternal and identical twins.

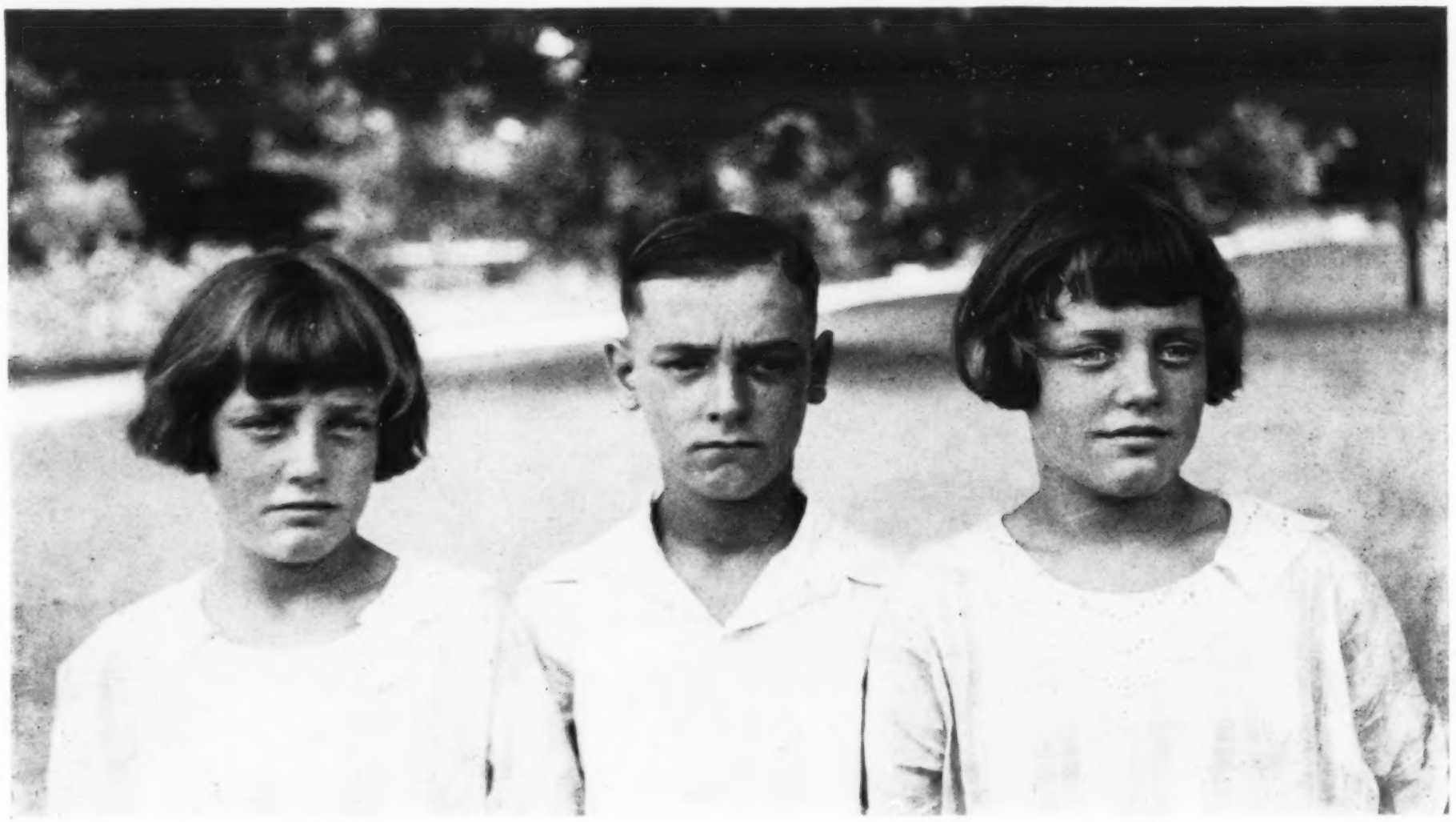
ASIDE from the fact that these triplets descended, through the mother, from a "twinning" stock, they are of interest because their intelligence quotients have remained in precisely the same order although their total range has never been greater than five points.

They were born May 19th, 1911. The pictures were taken at fifteen months and thirteen years of age. The girls appear to be "identical" twins, and the boy "just a brother." It will be observed that Maurice, the boy, was the first to begin teething and the first to walk and talk. He has always had the highest I. Q. and, until the girls reached the pre-adolescent spurt, was the tallest and heaviest.

To assume that the I. Qs. of 81 to 87 are related to the goitre and Addison's disease on one side of the family and to the alcoholism on the other would, indeed, be gratuitous. The facts point to another explanation, that these I. Qs. probably represent about the mode of the two families.

The following table gives the essential data:

	Maurice	Clarice	Phyllis
Order of appearance of teeth....	1	2	3
Order of walking	1	2	3



Phyllis Clarice

AT THIRTEEN YEARS

Figure 15

If the sex were the same, would they be considered identical triplets?

Order of talking	1	2	3	Height, May, 1921	52 ins.	50	49½
Mental age, May, 1922	9y-7m	9y-3m	9y-1m	Weight, May, 1921	59 lbs.	57	55
I Q.	87	84	82	Height, June, 1923	52½	54¼	54¼
Mental age, July, 1924	11y-2m	11y-0m	10y-8m	Weight, June, 1923	73	70¼	69
I. Q.	86	83	81	Height, Feb., 1925	59¼	59	59
				Weight, Feb., 1925	85	93	88¼
					Maurice	Clarice	Phyllis

Human Heredity

L'Eredita Nell'uomo, *by* Paolo Enriques. Pp. 386, with 90 figures, price, Lire 32. Francesco Vallardi, Milan, 1924.

A comprehensive and well-ordered work by the director of the institute of zoology and comparative anatomy of the University of Padua. It concludes with a strong plea for eugenics. An index and bibliography should be added.

P. P.

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NEW COTTON CHARACTERS FROM COLOMBIA AND ECUADOR

Adaptations of Possible Value in Cotton Breeding Found in Native South American Cottons

O. F. Cook and J. W. Hubbard
Bureau of Plant Industry

SEVERAL peculiar characters observed in native cottons of northwestern Mexico were described in this journal for December 1926. Other new characters, that have not been recognized in the Mexican cottons or in the varieties cultivated in the United States, were studied in May, 1926, on the west coast of South America. Two ports in Colombia were visited, Buenaventura and Tumaco; in Ecuador, three ports, Esmeraldas, Bahia de Caraquez, and Guayaquil. Cotton was found at each port, either in field cultivation or growing in yards about the towns.

Some of the South American cottons with the more outstanding differences have been treated as new species. Botanical descriptions have been published in a recent number of the *Journal of the Washington Academy of Sciences*, and type specimens deposited in the United States National Herbarium. The chief purpose to be served by describing the new species is that the range of characters in the genus Gossypium may become better known to breeders and students of genetics. Though it is not to be expected that many of the tropical cottons can be adapted to conditions in the United States, knowledge of their characters may be useful indirectly. After desirable characters have been recognized among the foreign cottons, parallel variations may be found in the stocks that are cultivated in the United States. Some of the characters may be utilized through hybridization, though most of the hybrids between different types of cotton are very unstable and unproductive.*

Outstanding Characters of New Species

At Buenaventura, a place noted for its wet climate, there are two species of cotton which do not have the buds and young bolls protected or enclosed by the involucres in the usual way. The suggestion is that closed involucres may not be desirable under conditions of excessive humidity. One of the open-involucre species, *Gossypium evertum*, has a full-sized involucre, but the bracts are strongly concave, or turned outward, away from the bud. This species was represented at Buenaventura by numerous individuals, all of a very uniform type, growing in different parts of the town. Also at Tumaco, about 200 miles south of Buenaventura, several typical plants of *Gossypium evertum* were found.

Open involucres of a different construction were found in *Gossypium tridens*. In this species the bracts are very narrow and have only 3 to 5 teeth; the smallest bracts and the fewest teeth in any American species of Gossypium thus far recognized. The bracts are not closed or appressed to the buds, but are set out from the receptacle on a narrow curved base.

Three species with the usual closed involucres were found in Ecuador. One type, seen only at Esmeraldas, was characterized by large auriform crests around the base of the calyx, and hence

*Cook, O. F., and Hubbard, J. W., New Species of Cotton from Colombia and Ecuador. *Jour. Washington Acad. Sci.*, 16: 545-552, Dec. 3, 1926.

called *Gossypium calycotum*, a name that means "calyx-eared." Five plants were examined in door-yards about the town, and apparently represented a definite and uniform type.

A second species from Esmeraldas was named *Gossypium auritum*, on account of the very broad auricles of the involucral bracts. It was found in a field planting on a steep slope about one mile back of the town, and the same species was collected from door-yards at Bahia de Caraquez. The auricles of the bracts are expanded on the inner margins and often overlap across the pedicels.

A single plant of *Gossypium quinacre* was found in an open uncultivated place at Bahia, and possibly was a hybrid, but it showed several characteristics not previously recognized. The most remarkable peculiarity was an absence of 3-lobed leaves, which in most of the species of Gossypium are the dominant type of foliage. The name *quinacre* means 5-pointed in reference to the peculiar leaf-form.

Other kinds of cotton were found at each port, including several forms of kidney cotton, but the five aforementioned types had special outstanding characters not previously recognized. Many of the South American cottons are so closely associated with the Sea Island series that they are reckoned as varieties of a single species, *Gossypium barbadense*, Linn., or as intermediates between *Gossypium barbadense* and *Gossypium peruvianum*. The affiinities of the Mexican cottons are probably with the Upland series, rather than with the Sea Island, though some of their characters suggest Sea Island relationships.

Species Distingushied from Hybrids

Difficulties are recognized in distinguishing natural, established types from aberrant hybrid forms with no stability of characters that would enable them to be identified in the future. But there are well-known facts of breeding that somewhat simplify this problem. It is only the first generation of hybrid cotton plants that are closely alike. In the second and later generations of hybrids a wide range of individual diversity is found, with scarcely two plants alike.

Thus the finding of even a few plants that are closely alike, scattered about in a native community, establishes a fair probability that they are not hybrids. Unless other forms are present to represent one or both of the parental types, from which an intermediate first generation of uniform plants could be produced, hybridity is not indicated. A group of uniform individuals may be taken as a natural type, with a complex of characters that it may be of interest to describe, especially if any outstanding features are represented.

Involucres with Out=turned Bracts

In one of the South American cottons from Buenaventura, Colombia, the bracts of the involucre are turned back, so that the buds and young bolls are not covered or protected from above, but are fully exposed. On account of this peculiarity, the species was named *Gossypium evertum*.

The bracts of other American cottons are convex, or at least flat on the outer surface, but *Gossypium evertum* has strongly concaved bracts; not only bent back at the end, but revolute on the margins. Thus the bracts stand out separately instead of approaching or forming an enclosure around the bud. This departure from the usual form and function of the bracts may be considered as an adaptation to humid tropical conditions.

The rudimentary calyx and closed involucre of Gossypium are specialized features suggestive of dry-country origins for this group of plants. In humid climates the closed involucre apparently is not necessary and this species with everted bracts may be considered as a specialization away from the closed involucre, not by reducing the bracts, but by changing their position. Such open involucres undoubtedly would offer less shelter for boll-weevils, boll-worms, and diseases like anthracnose, or for bacteria that cause boll-rot, than would the usual closed involucres.

It would be an advantage in a commercial cotton to have the involucres turned back from the bolls, since the fibre undoubtedly could be harvested with less admixture of "trash," which consists principally of broken bract material. Since the amount of trash largely determines the commercial grade of the fibre, bracts that turned back from the bolls would tend to less trash and to better grades of cotton. The other characters of the species were somewhat like Sea Island cotton, and suggest the possibility of finding an open-involucre type of Sea Island cotton in tropical America.

Involucres with Narrow Bracts

Another departure from the usual closed involucre was found, also at Buenaventura, in a type of cotton with very small bracts, narrow and separate. The bracts have an abrupt curvature near the base so that they stand out from the bud or boll. Many of the bracts have only 3 teeth, the others only 4 or 5 teeth. This species, which has been described as *Gossypium tridens*, meaning "three-teeth," has the smallest bracts and the fewest teeth of any of the true cottons yet described. The very small three-toothed bracts suggest the related genus Thurberia, the so-called "wild cotton" of Arizona.

Buenaventura is in the district of very heavy rainfall, with little interruption throughout the year, where cotton would not be expected to exist as a native plant, in heavy forest vegetation. Although most of the cottons probably developed in regions with less continuous rainfall, the finding of these two remarkable departures from closed involucres tends to confirm the suggestion that the cotton involucre is an adaptation to drought conditions, where flowering and fruiting might depend on special protection of the bud.

The cotton flower is peculiar in having a specially reduced calyx, too small to cover the bud except in the early stages, but the bud is enclosed in a large involucre that supplies the protective function of a calyx. Unfortunately, the large involucre also protects the boll-weevil and keeps weevil-infested buds from the prompt drying that would destroy the weevil larvae. Thus the breeding of weevils in the buds might be greatly reduced or prevented in a cotton that had no involucre, or only a small involucre as in the related genus Thurberia, where weevils do not breed in the buds, but only in the capsules.

The existence of wild or unimproved cottons with small or open involucres that do not enclose the buds is a further indication that it may be possible to find small-involucre cottons that can be used in the United States or to reduce or "breed off' the involucres by selection among our good varieties in the United States.

It is probable that under ordinary cultural conditions the involucre is unnecessary. Buds that have their involucres eaten off by caterpillars or cut off experimentally are able to develop normally into flowers and bolls. The Acala cotton, a superior Upland type introduced by the Department of Agriculture from southern Mexico has a notable tendency to smaller involucres than the Texas big-boll type of cotton.

Bracts with Numerous Teeth

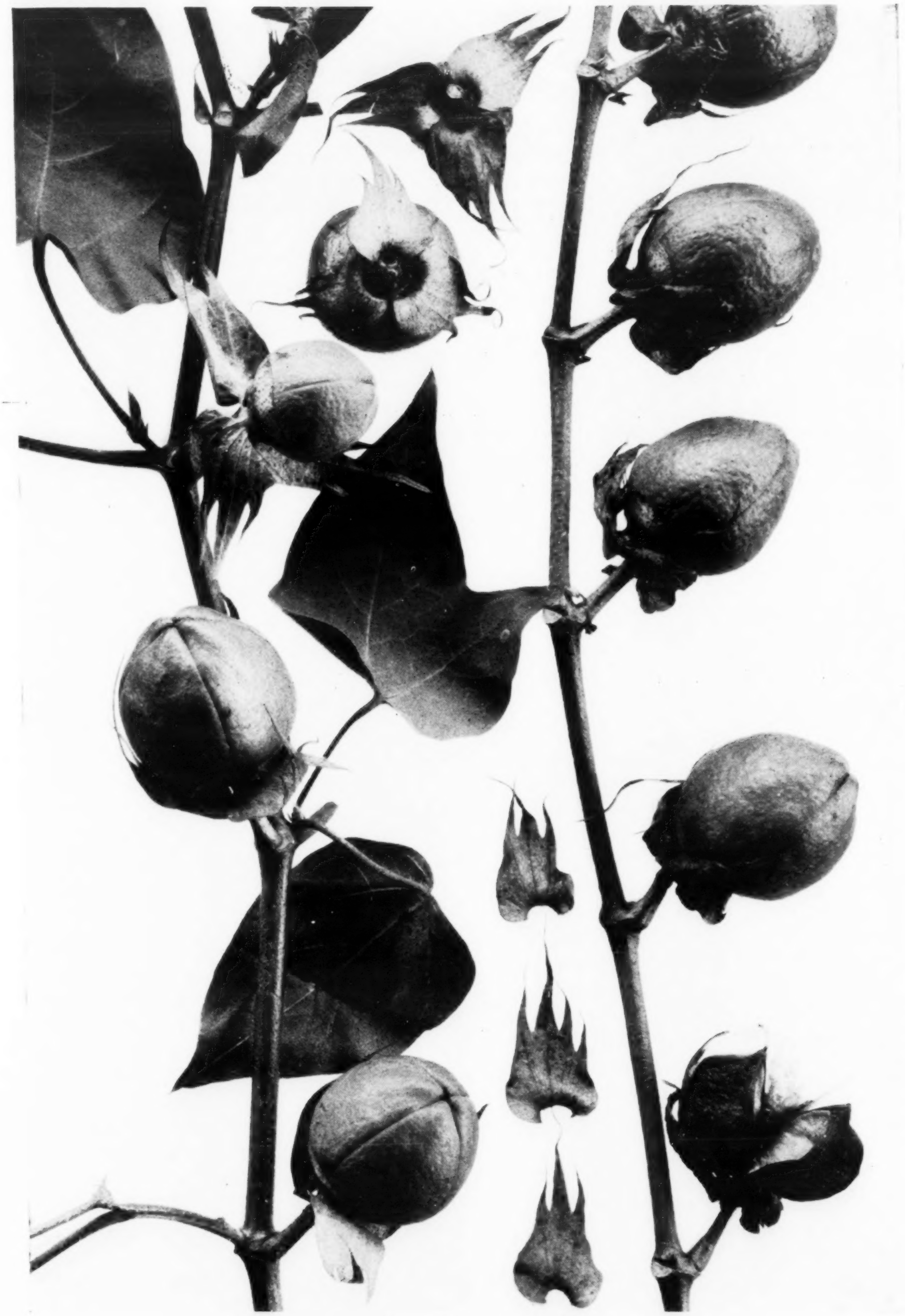
In contrast with the very small bracts of *Gossypium tridens,* some of the South American cottons have very large bracts, with numerous marginal teeth. The bracts of *Gossypium auritum* and *Gossypium quinacre* usually have from 17 to 19 teeth above the point of attachment to the receptacle, the auricles being entire on the lateral margins as well as around the base. Also the teeth of these large bracts are narrower and more slender than usual, and the size of the teeth gradually decreases along the margins of the bracts, the lower teeth becoming very minute. Some of the larger apical teeth are often divided into two points.

The largest number of teeth recorded for bracts in Watt's monograph of the Genus Gossypium is under *Gossypium mustelinum,* a species recorded from Brazil and Colombia. In drawings of this species the bracts are shown with

A COTTON WITH OUT-TURNED INVOLUCRES

Figure 16

Cotton with open involucres would afford less protection for boll-weevils and fungus diseases that attack the buds or bolls. In one of the South American cottons the bracts are strongly everted in the upper part, and the margins also rolled back from the buds, which thus are exposed to the sunlight and a free circulation of air. Such a turning back of the bracts away from the open boll might also prove advantageous in reducing the "trash" or broken bract material picked with lint, thus raising the "grade" of the cotton. *Gossypium evertum*, natural size.



COTTON WITH THE SMALLEST BRACTS

Figure 17

A species of tree-cotton from Colombia, a tall plant with rather open foliage, small round bolls, and open involucres, very distinct from the other South American types, on account of its small involucres with narrow widely separated bracts, often with only 3 teeth, never more than 5 teeth. Other distinctive features of this species are the peculiar 2-lobed leaves, and a persistent pubescence of simple hairs, instead of the stellate or clustered hairs of other species of cotton. *Gossypium tridens*, natural size.

18 and 19 teeth, but the margins are deeply toothed throughout with the lowest pair of teeth projecting into the "cordature," or sinus at the base of the bract.

Bracts with Middle Teeth Not Prominent

In the bracts with the numerous teeth there is a lack of the usual prominence of the three middle teeth. In most kinds of cotton the three middle teeth usually stand out rather prominently, being somewhat larger than the others, and often there is a distinct step or gap on each side of the middle group of three teeth, while the marginal teeth form a regular succession.

Reasons have been given for believing that the three middle teeth of the cotton bracts are distinct morphologically from the others. Considering the bracts as reduced leaves, it appears that the three middle teeth correspond to leaf-lobes, while the lateral teeth represent enlarged or reduplicated stipules of foliage leaves.

The lack of special prominence of the middle three teeth in many of the South American cottons may mean that a more complete assimilation in the forms of the two kinds of teeth has taken place, along with the increase to a larger number of teeth. Another possibility to consider is that in some types of cotton more than three teeth in the middle of the bract have been derived from leaf-lobes instead of from stipules, also it is possible that in some cases only one tooth represents the blade of the leaf, while the other teeth correspond to the stipules.

Bracts with Overlapping Auricles

The auricles of bracts are expansions of the basal area, below the line of attachment of the bract to the receptacle. A sinus is formed between the auricles of a bract as at the base of a leaf, except that the middle of the bract sinus is occupied by a section of the receptacle, with a nectary at the center. In bracts with short auricles the inner margins usually diverge from the pedicel, while on longer auricles the margins usually are more or less parallel with the pedicel, especially if the margins of adjoining bracts are united at the base.

An extreme development of the auricles of the bracts occurs in one of the South American species, *Gossypium auritum*, where the auricles are expanded to such an extent that they meet and overlap across the pedicel, so that the nectary-area of the receptacle is entirely surrounded by the expanded auricles of the bract. The same tendency appears, to a less extent in the bracts of *Gossypium quinacre*, these two species contrasting notably with *Gossypium calycotum* (Figure 18) where the inner margins of the bracts are united and divergent from the pedicel.

Involucres with Prominent Nectaries

The cotton plant has extra-floral nectaries on the leaves and also at the base of the involucre. There are six involucral nectaries, in two sets of three each. The outer nectaries are located on the receptacle in the sinus of the bracts and the inner nectaries are between the bracts, at the base of the calyx. The nectar-bearing area is covered with close-set papillae, in contrast with the surrounding surface, which is smooth and naked or beset with oil-glands.

In many species of cotton the nectaries are located in pits or depressions of the surface, usually the outer nectaries in rounded pits and the inner nectaries in transverse grooves or furrows. Some of the South American cottons have the nectaries very large and prominent instead of being placed in depressions. The largest nectaries are so broad as to cover most of the receptacle, and are abruptly raised above the surrounding surface like a small square or oblong platform, or the frustum of a cone. In other cases only the rim of the nectary may be prominent while the surface of the nectary is sloping or depressed. The inner nectaries are not raised above the surrounding surface, but there is

no groove or depression in the nectary or around it. Species that have large prominent nectaries include *Gossypium auritum*, *Gossypium calycotum* and *Gossypium evertum*, ranking somewhat in this order. The nectaries of *Gossypium quinacre* are relatively small, while those of *Gossypium tridens* are set in depressions.

Calyx with Auriform Crests

A cotton found at Esmeraldas, Ecuador, has peculiar ear-like crests running around the lower part of the calyx, somewhat parallel with the insertion of the bracts. Usually the crests are interrupted immediately below the inner nectaries, and often at intermediate points, without regularity.

On account of the placing of these crests in relation to the nectaries a morphological correspondence to bractlets may be assumed. The inner nectaries and bractlets may represent a series of suppressed bracts, as though the involucres were double or had consisted of twice as many bracts. Examples of double involucres were noted last year in Mexico, but were not studied carefully.

The bractlets have been considered as supernumerary stipular elements that correspond morphologically to the ordinary divisions or teeth of the bracts, but have failed to unite. However, it is conceivable that the bractlets are rudiments of an alternate series of bracts that in most of the cottons have been entirely suppressed. Under such an assumption the remarkable crests of *Gossypium calycotum* might also be considered as rudiments of suppressed bracts.

Carpels with Many Seeds

The number of seeds per lock is one of the most diverse characters found in Gossypium, ranging from a single seed in *G. drynarioides* to from 15 to 20 seeds in some of the varieties referred to *G. arboreum* (Garo Hill cotton).

In most of the highly developed fiber-yielding species, the number of seeds per lock ranges from 7 to 9, rarely 10 or 11, and an increase in number and decrease in size is considered a favorable variation from the commercial standpoint, as more lint can grow on two small seeds than on one large seed, if the volume be the same.

Small seed of the same number will increase the lint percentage, and at the same time reduce the acre yield, thus causing much confusion among cotton growers. Where the number of seed remains the same, a reduction in size of seeds has the effect of increasing the percentage of lint, though less fiber is produced. On the other hand, with larger seeds, but the same percentage of lint, the yield of lint is increased, for the same percentage with a large seed means more lint per seed.

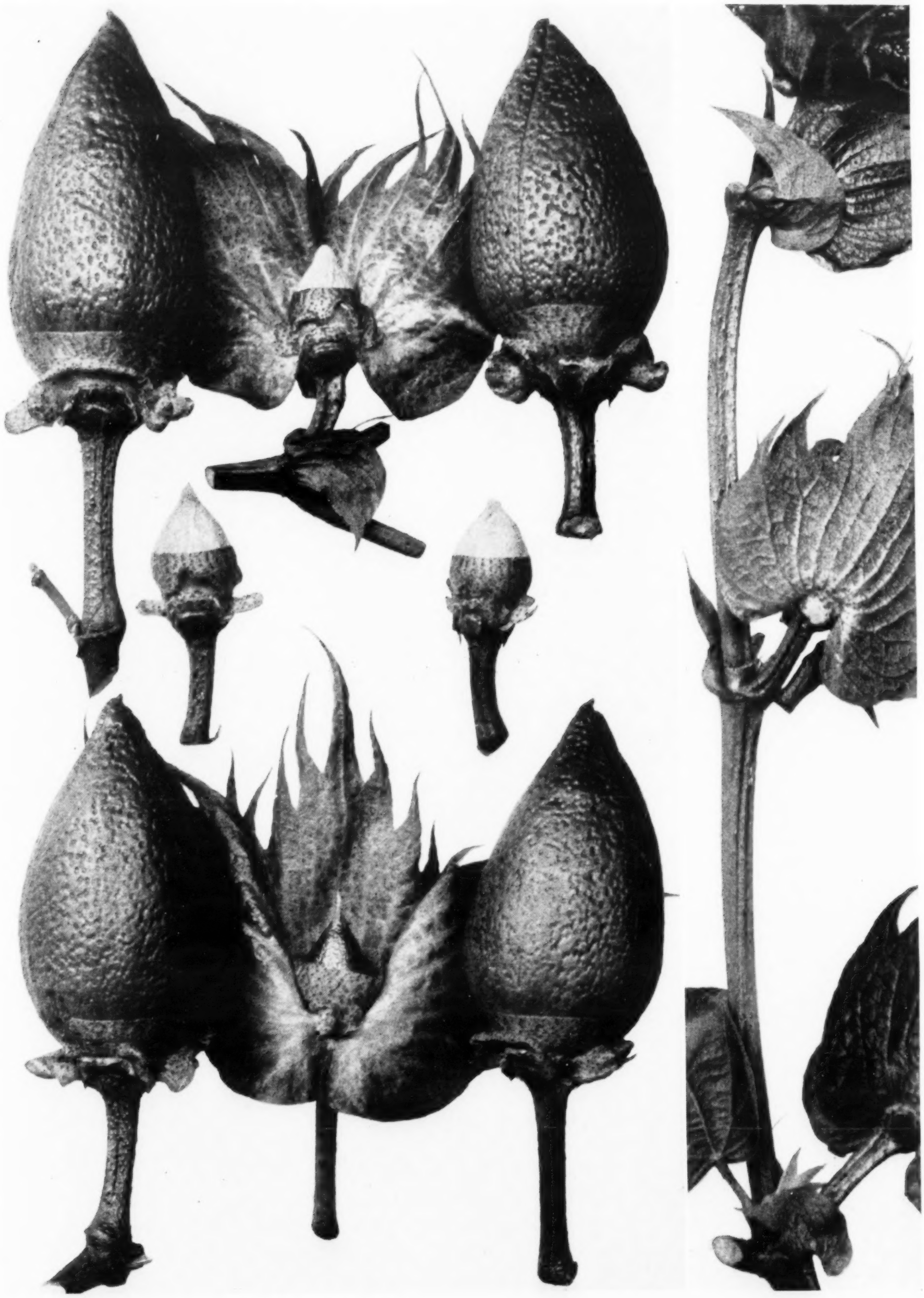
By reducing the size and increasing the number, the same amount of seed material would produce more lint-bearing surface, therefore increasing the lint percentage and at the same time increasing the amount of lint per boll.

Such a variation has been found in one of the species recently described from Esmeraldas, Ecuador, *Gossypium auritum*, which has 12 or 13 seeds per lock. Many bolls were examined and none found to contain less than 12 seeds per lock and, in numerous cases, 13 seeds per lock.

The adaptation of this species for commercial planting in the United States is rather doubtful though it is being grown commercially in Ecuador. The fields visited at Esmeraldas were planted in rows about 12 feet apart and the plants were about 10 or 12 feet apart in the rows, much resembling a young peach orchard, the plants being pruned back to about five or six feet.

Seeds Naked at Base

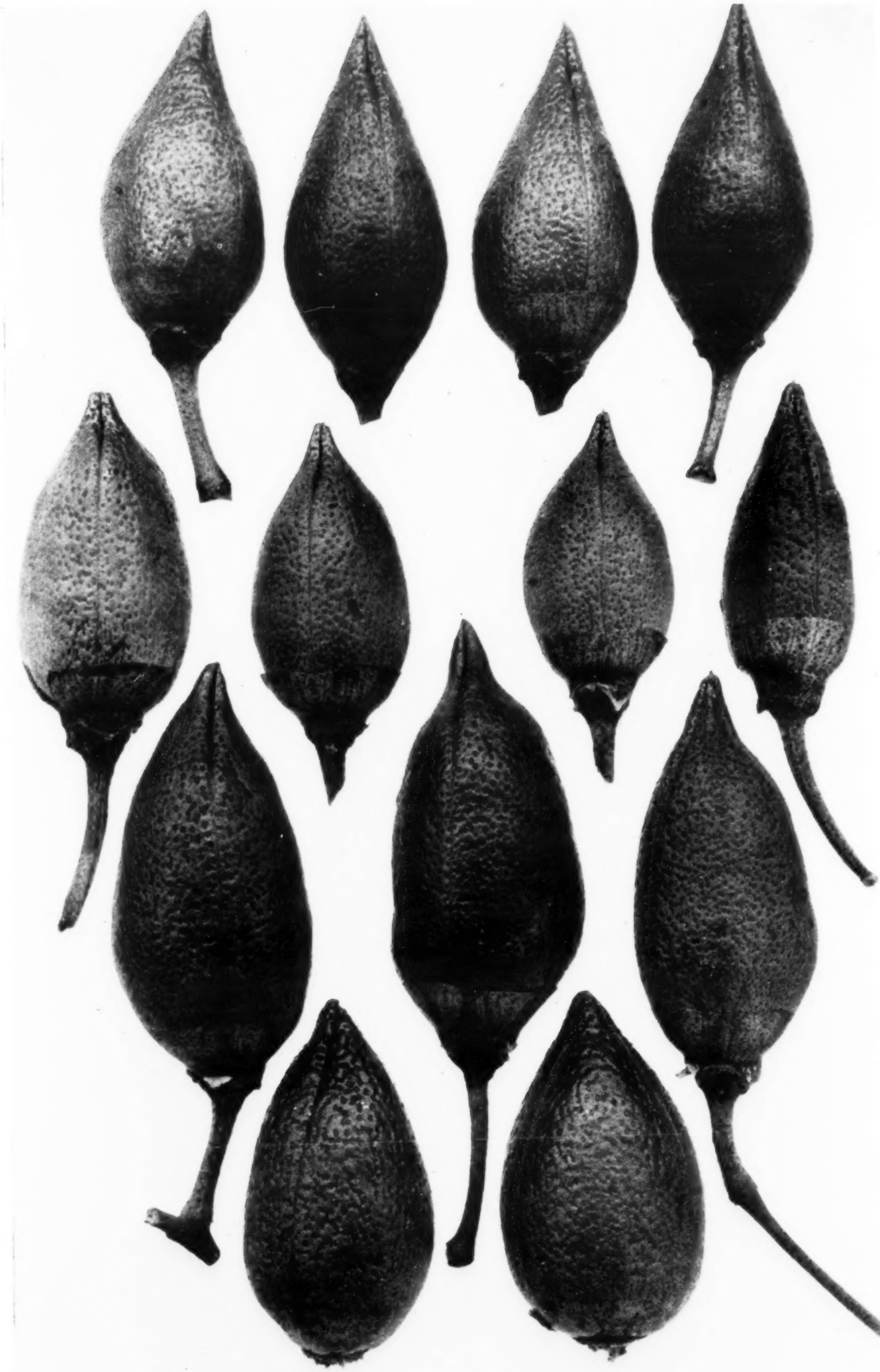
In one of the species recently described from Colombia, *Gossypium evertum*, the basal portion of the seed is in most cases entirely naked, with a distinct band of fuzz around the seed near the center, and a small tuft at the tip. The lint is produced on the portion of the seed above the band of



AURICLES ON A COTTON CALYX

Figure 18

A remarkable development of "ears" or "ruffles" around the base of the calyx in a new species of cotton found at Esmeraldas in the northern part of Ecuador. Note also the large, prominent nectaries of the involucre, found in several of the South American cottons, and the very large unequal stipules. *Gossypium calycotum* (natural size).



BOLLS OF SOUTH AMERICAN COTTONS

Figure 19

Comparative sizes, shapes, and surface characters of the bolls of four of the new South American species; the rows from top to bottom, *G. evertum, G. quinacre, G. auritum, and G. calycotum,* natural size.

INVOLUCRES WITH OVERLAPPING BRACT AURICLES

Figure 20

One of the new species from Ecuador that was found under cultivation in a field at Esmeraldas, and growing in a yard near the sea at Bahia. The distinctive features are the large involucres with very broad auricles at the base, often overlapping across the pedicel and the large bolls with numerous seeds. *Gossypium auritum* (natural size.)

A TREE COTTON

Figure 21

This species of cotton, *Gossypium tridens*, probably grows to a height of 20 feet or more. This plant had a single trunk four inches in diameter about two feet from the ground. The trunk had been cut off about eight feet from the ground, but had grown several new shoots eight or ten feet long. Most of the so-called "tree cottons" are large spreading shrubs.

fuzz or beginning in the fuzzy area, but never below. Many plants of this species were found at Buenaventura, and Tumaco, Colombia, and the arrangement of the lint and fuzz on the seed was quite constant in all plants observed.

Regarding the arrangement of lint and fuzz on the seeds the following statement may be quoted:

> In most of the different species and varieties of cotton the seed produces two distinct kinds of hairs. The long hairs represent the commercial fiber, or lint, and the shorter, finer hairs represent the fuzz left on the seed after ginning. . . . In the Upland type of cotton the two kinds of hairs are mixed together over the whole surface of the seed, but in other sorts there are definite differences in the position of the lint and fuzz. In the Egyptian cottons there is a strong tendency to restrict the fuzz to the ends of the seed and the lint to the intermediate position. A peculiar form of Sea Island cotton found in a locality called San Lucas, in eastern Guatemala, between Cajabon and Senahu, shows the most extreme specialization of the two kinds of hairs on the seed. The lower half of the seed is without lint, but has a dense, velvety covering of bright-green fuzz. The upper half of the seed produces lint but no fuzz.*

It is well known to cotton breeders that variations in lint and fuzz characters are of common occurrence, notably the so-called "slick-seeded" variations of Upland cotton with little or no fuzz. In most of the slick-seeded plants the lint is less abundant and often is very sparse. In some cases the seeds are entirely naked, so that they drop out on the ground as soon as the bolls open. The tendency to slick seeds is recognized as one of the forms of degeneracy and the removal of such plants is one of the objects of roguing the seed-stocks of well-bred varieties.

Bolls with Two Carpels

The finding of numerous 2-locked bolls in *Gossypium quinacre* seemed noteworthy because no other bolls with two locks had been observed among the South American cottons, and because the reduced number of locks in the bolls was in striking contrast with the extra lobing of leaves, all with 5 to 7 lobes, none with 3 lobes or simple.

None of the bolls had more than three locks, while many had only two, perhaps a third of those examined, though a count was not made. A 2-locked boll is found occasionally in Egyptian and Sea Island cotton, but 4-locked bolls are much more frequent, and even 5-locked bolls are not uncommon in pure Sea Island stocks. Assuming that the full number of carpels was shown in the plant of *Gossypium quinacre*, in view of the favorable conditions of growth, a tendency to reduction of the carpels is indicated.

Two-locked bolls are often found in Egyptian hybrids, and may be considered as evidence of hybridization when they occur in large numbers, though the general tendency of Egyptian hybrids is to produce greater numbers of 4-locked and even 5-locked bolls.

A frequent occurrence of 2-locked bolls would not seem strange under drought conditions or in poor soil, where the plants fruited under stress conditions, but under conditions of luxuriant growth a full expression of all characters would be expected, and such a reduction in the number of carpels must be considered as a hereditary tendency.

Leaves with Two Lobes

Consistent differences in the leaf forms may appear not only between the two kinds of branches, but also between different positions upon the fruiting branches. In *Gossypium tridens*, one of the new species from Colombia, the first leaves of the fruiting branches were commonly 3-lobed and the succeeding leaves were all 2-lobed. All of the leaves on a branch were often 2-lobed, but it was observed that where 3-lobed leaves occurred they always occupied successive positions beginning at the first joint. A few simple leaves were found on this species, but in most

*Cook, O. F. and R. M. Meade. Arrangement of Parts in the Cotton Plant. *B.P.I. Bulletin* 222, Oct. 3, 1911, pp. 22 and 23.

cases they were greatly reduced and abnormal, usually appearing on vegetative branches that developed from nodes of fruiting branches, and having only 1 or 2 leaves.

Absence of Three-Lobed Leaves

The leaves of cotton plants usually show great diversity of forms, even on the same plant, and in the best-bred varieties. The leaves of young seedlings are simple and entire, while those of adult plants have angular lobes, more or less deeply separated and sometimes with coarsely toothed margins. The size and shape of the leaves, and the number of lobes have more or less definite relations to the positions of the leaves on the plant. In the genus Gossypium a wide variation of leaf forms seems less remarkable than a more constant occurrence of one form of leaves or an absence of some of the forms that are commonly present.

The leaves of fruiting branches generally are smaller and less divided than the leaves of the main stalk and the vegetative limbs. Leaves with three lobes are the usual form on fruiting branches and often there is a definite contrast between the 3-lobed fruiting branch leaves and the larger 5-lobed and 7-lobed leaves of the main stalk and the vegetative branches. Some of the fruiting branch leaves may be simple like the seedling leaves or may have a lobe only on one side. As a general rule, the largest number of lobes produced on fruiting branch leaves is equal to the smallest number of lobes produced on the leaves of the main stalk or the vegetative branches.

In one of the new species from Ecuador, *Gossypium quinacre*, all of the fruiting branch leaves had five lobes, while the leaves of the main stalk and vegetative branches also had five lobes, except a few that had seven lobes. The complete absence of 3-lobed leaves is a unique character, which probably would not appear constant under less favorable conditions, but in other types of cotton no such absence of 3-lobed leaves would be expected to occur under any conditions.

Leaf Nectaries Reduced

Leaf nectaries are usually considered as a widely fluctuating character, though showing more regularity in some varieties than in others. In some species the number of nectaries increases with the number of leaf lobes. Simple leaves and those with three lobes more often have only one nectary, while leaves with five or seven lobes frequently have three nectaries. Other cottons usually have three nectaries on the leaves of the main stalk and vegetative branches, but only one nectary on leaves of the fruiting branches.

The usual tendency to increase the nectaries with the leaf lobes is not followed in *Gossypium quinacre*, the new species from Ecuador with the 5-lobed leaves on the fruiting branches. In no case was more than one nectary found on any fruiting branch leaf. Three nectaries were found on many of the leaves of the main stalk, but some of the large 7-lobed leaves had two nectaries and others only one. Such contrasts between the numbers of lobes and nectaries have not been recorded for any other cotton.

Pubescence of Simple Hairs

The leaves, stems, and involucres of most kinds of cotton plants are pubescent, or covered with fine short hairs. The pubescence usually is more abundant on the new or recent growth, and on the lower sides of the leaves. The occurrence of simple pubescence in one of the South American cottons is remarkable because the usual form of pubescence is stellate, with several small hairs attached to the same base, forming a minute tuft or star-shaped cluster.

The form of the pubescence in cotton may have a practical relation to the grade and commercial value of the fibre because it is impossible to keep out a small intermixture of "trash" or broken leaf material that is picked with the cotton and adheres to the

fibre. Much of the trash can be separated by cleaning machinery at the gin, but some of the trash is broken into minute particles that become entangled with the fibres so that no separation is possible. These entangled fibres either are combed out as waste in the spinning process or remain in the spun threads and blemish the finished fabrics.

Much of the difficulty of cleaning out the small particles of broken leaves and bracts arises from the nature of the pubescence, because the stellate tufted hairs serve like a special device for catching and entangling the fibres. Thus the finding of a cotton with simple hairs suggests a new possibility that might have important relations to the picking of cotton in the field, the cleaning of the cotton at the gin, and the spinning operations. Varieties with simple pubescence, rather than stellate, might be valued for that character as well as for those that are now recognized, as earliness, productiveness, and quality of staple. Another possibility would be to find varieties that have naked surfaces or that shed the hairs of the leaves and bracts in the early stages of growth as some of the South American cottons apparently do, so that there would be no small hairs to entangle the fibres and keep the "trash" from being separated by the cleaning machinery.

Animal Breeding

BREEDING AND IMPROVEMENT OF FARM ANIMALS, *by* VICTOR ARTHUR RICE, Assistant Professor of Animal Husbandry, Massachusetts Agricultural College. Pp. 349. The McGraw-Hill Book Company, New York, 1926.

This production in the field of animal breeding is a very useful compilation of information selected from the best available sources and arranged by the author to meet the needs of a college text. The first quarter of the book deals with the general introductory subjects such as sex organs, fertility, sterility, and parturition; the second quarter takes up the subject of genetics; and the last half is given over to a discussion of such subjects as inbreeding, selection, breed analysis, and fitting for sale. A valuable appendix includes a short chapter on biometry and a chapter which gives a summary of the known factors concerning the genetics of farm animals. Lists of pedigree register associations and reference texts complete the volume.

The book is one of the best available texts in animal breeding. There are, however, a few loose statements and a sprinkling of typographical errors throughout the book. From the standpoint of coherence it is a little difficult to understand why the chapter dealing with the physical basis of heredity has been placed near the front of the book and so far away from that part of the volume which deals with Mendelism.

H. C. M.